

JPRS 69724

1 September 1977

USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS  
GEOPHYSICS, ASTRONOMY AND SPACE  
No. 404

20000405 168

U. S. JOINT PUBLICATIONS RESEARCH SERVICE

DISTRIBUTION STATEMENT A

Approved for Public Release

Distribution Unlimited

Reproduced From  
Best Available Copy

U S S R

EAST  
EUROPE

#### NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

#### PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22151. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available through Bell & Howell, Old Mansfield Road, Wooster, Ohio, 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

<b>BIBLIOGRAPHIC DATA SHEET</b>		1. Report No. <b>JPRS 69724</b>	2.	3. Recipient's Accession No.
4. Title and Subtitle <b>USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS - GEOPHYSICS, ASTRONOMY AND SPACE, No. 404</b>			5. Report Date <b>1 September 1977</b>	6.
7. Author(s)			8. Performing Organization Rept. No.	
9. Performing Organization Name and Address <b>Joint Publications Research Service 1000 North Glebe Road Arlington, Virginia 22201</b>			10. Project/Task/Work Unit No.	
			11. Contract/Grant No.	
12. Sponsoring Organization Name and Address  <b>As above</b>			13. Type of Report & Period Covered	
			14.	
15. Supplementary Notes				
16. Abstracts  The report contains abstracts and news items on meteorology, oceanography, upper atmosphere and space research, astronomy and terrestrial physics, covering both science news and formal scientific reports. Published details of Soviet space spectaculars are included.				
17. Key Words and Document Analysis. 17a. Descriptors  USSR Geophysics Astronomy Astronautics Meteorology Oceanography				
17b. Identifiers /Open-Ended Terms  				
17c. COSATI Field/Group <b>3, 4A, 4B, 8, 22</b>				
18. Availability Statement <b>Unlimited Availability Sold by NTIS Springfield, Virginia 22151</b>			19. Security Class (This Report) <b>UNCLASSIFIED</b>	21. No. of Pages <b>55</b>
			20. Security Class (This Page) <b>UNCLASSIFIED</b>	22. Price

## USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

## GEOPHYSICS, ASTRONOMY AND SPACE

No. 404

This serial publication contains abstracts of articles and news items from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

Photoduplications of foreign-language sources may be obtained from the Photoduplication Service, Library of Congress, Washington, D. C. 20540. Requests should provide adequate identification both as to the source and the individual article(s) desired.

	CONTENTS	PAGE
I.	ASTRONOMY.....	1
	Abstracts of Scientific Articles.....	1
	Radiation from Front of Magnetohydrodynamic Shock Wave.....	1
	Mechanism of Formation of Loop Prominences.....	2
II.	METEOROLOGY.....	3
	News.....	3
	Symposium on Modeling of Climatic Variations.....	3
	Abstracts of Scientific Articles.....	4
	Effectiveness of Antihail Work in Bulgaria.....	4
	Method for Determining Isotopic Composition of Fallout.....	4
	Analytical Representation of Integral Cloud Transmission Function.	5
	Kinetics of Condensation-Coagulation Processes in Atmosphere.....	5

	<u>Page</u>
Transmission of Solar Radiation by Trade Wind Zone Cloud Cover...	6
Effect of Temperature Stratification on Cloud Convection.....	7
Effect of Turbulent Intensity of Currents on Bottom-Limit Nonscouring Velocities.....	7
Long-Term Cyclicity of Circulation Characteristics.....	8
III. OCEANOGRAPHY.....	9
News.....	9
Report on Underwater Research in Lake Baykal.....	9
Research Submarines Used to Study Lake Baykal.....	11
Abstracts of Scientific Articles.....	14
Computing Fine Structure of Density and Velocity Fields.....	14
Dispersion Expressions for Gravitational and Rossby Waves.....	14
Meandering of Cromwell Current.....	15
Optimum Conditions for Towing of Magnetometer.....	15
Acoustic Methods for Registry of Surface Waves.....	16
Increasing the Accuracy of Current Computations.....	17
Variations in Emissivity of Water Surface.....	17
Exploration and Exploitation of Natural Gases at Sea.....	18
Organic Carbon in Bottom Sediments of Chukotsk Sea.....	18
Prospects for Petroleum and Gas in Indian Ocean.....	19
Systematic and Random Errors in Determining Ship Position.....	19
Evolution of the Hydrosphere and Ocean Level.....	20
IV. TERRESTRIAL GEOPHYSICS.....	21
News.....	21
Belousov Comments on International Geophysical Research.....	21

	<u>Page</u>
Notes on Earthquakes and Climatic Change.....	22
Abstracts of Scientific Articles.....	23
Modeling of Wave Propagation in Radially Inhomogeneous Model of Earth.....	23
Method for Discriminating the Normal Geomagnetic Field.....	23
Change in the Intensity of Oscillations with Depth.....	24
Bottom Geothermal Survey in Caspian Sea.....	24
Paleozoic and Mesozoic Reconstructions of Continents and Oceans.....	25
Maps of Maximum Possible Earthquakes in Armenian Highland.....	25
Crustal Structure in Southern Part of Sea of Okhotsk.....	26
Changing Models of the Earth's Upper Mantle.....	27
Determining Structure of Focal Radiation of Strong Earthquake...	27
Principal Types of Major Structures of Lithospheric Plates.....	28
Tectonic Periodization of Earth's History.....	28
Influence of High-Resistance Basement on Magnetovariation Sounding Curves.....	29
Study of Crumpling of Borehole Casings in Tectonic Zones.....	30
Diversity of Types of Igneous Rocks on Earth-Group Planets.....	30
Behavior of Seismic Waves in Partially Melted Medium.....	31
Corrections for Dynamic Shear Modulus for Love Numbers.....	32
Dislocations at Earthquake Foci Before and After Earthquakes....	32
V. UPPER ATMOSPHERE AND SPACE RESEARCH.....	34
News.....	34
TASS Announces Launching of "Kosmos-931".....	34
TASS Announces Launching of "Kosmos-932".....	34
TASS Announces Launching of "Kosmos-933".....	34

	<u>Page</u>
All-Union Conference on Atmospheric Optics.....	35
Interview with Candidate of Technical Sciences V. Nesterov.....	36
Notes on Photographic Observations from Space.....	36
Abstracts of Scientific Articles.....	38
Global Physical Processes and the Environment.....	38
Diurnal Variations of Leaking Corpuscular Radiation.....	39
Trail of Body Moving Rapidly in Magnetized Plasma.....	39
Effect of Ionospheric Disturbances on Polarization Fading Frequency.....	40
Review of Study of Natural Resources by Remote Sensing.....	40
Model of Lunar Gravitational Field.....	41
Use of Minimum Moduli Method in Adjustment of Observations.....	42
Use of Gradient Method in Studying Spaceflight Dynamics.....	42
Coding of Signals in Ionospheric Sounding.....	43
Processing of Space Photographs of Seas of USSR.....	44
Motion of Beam of Charged Particles in Magnetosphere.....	44
Sidereal-Diurnal Cosmic Ray Variations.....	45
Separation of Cosmic Ray Variations of Different Origin.....	45
Determining Atmospheric Turbidity from Pyranometric Measurements .....	46
Optimum Parameters of Satellite with Two Stabilizers.....	46
Compensation of Eccentric Oscillations of Satellite.....	46
Photoelectrons and Electrons in Plasmosphere.....	47
IR Spectra of Lunar Regolith.....	47
Correlation Between Cosmic Ray Variations and Solar Activity...	48
Space Research for Studying Earth's Natural Resources.....	49
Use of Multispectral Photography in Remote Prospecting.....	49

## I. ASTRONOMY

### Abstracts of Scientific Articles

#### RADIATION FROM FRONT OF MAGNETOHYDRODYNAMIC SHOCK WAVE

Moscow PIS'MA V ASTRONOMICHESTKIY ZHURNAL in Russian Vol 3, No 6, 1977 pp 273-277

[Article by V. G. Ledenev, Siberian Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Electromagnetic Radiation from the Front of a Magnetohydrodynamic Shock Wave"]

[Abstract] Electromagnetic radiation is created by the regular transformation of plasma waves excited in front of the shock wave on an inhomogeneity of its front. The accumulation of the energy of plasma waves increases the effectiveness of this transformation. This mechanism is used for interpretation of type-II solar radio emission. An explanation of the weak polarization of type-II bursts is given. It is suggested that this is associated with the background from type-III bursts, against which type-II bursts are frequently observed. This background for type-II bursts evidently always exists because there are always high-energy particles escaping sufficiently far from the shock wave front, but its intensity can be different. This means that in front of the shock wave front there is an extensive region where the energy density of plasma waves exceeds the thermal level. The electromagnetic waves, passing through this region, will interact with the plasma waves, that is, there will be induced scattering of electromagnetic waves into plasma waves and vice versa. The induced scattering of plasma waves into electromagnetic waves on thermal ions is not important for waves excited at greater distances (at a distance  $\sim 10^8$  cm). For waves excited at greater distances from the front it can be important and interaction precisely with such waves can explain weak polarization of type-II radiation.

[196]



## MECHANISM OF FORMATION OF LOOP PROMINENCES

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 3, No 6, 1977 pp 283-286

[Article by L. N. Ivanov and Yu. V. Platov, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation and Spectroscopy Institute, "Mechanism of Formation of Loop Prominences"]

[Abstract] The authors have formulated a qualitative picture of the development of loop prominences. In active regions on the sun it is common to observe such an arrangement of spots that the configuration of the magnetic field lines of force in the vertical plane has a distinctive form. In the region of the zero point X of the magnetic field (which is some distance aloft) under definite conditions it is necessary to expect the development of a current layer in which there is rejoining of the magnetic lines of force. Because of its properties the matter will be drawn in two directions -- upward and downward from the point X. Since the gas acceleration is perpendicular to the lines of force and there is inertial motion along them, with an increase in the magnetic moments of the pairs of spots or with the approach of spots there should be an increase in the density of matter in the region aloft and in the region near the surface separated by the neutral point. In addition, the effect of gravity should lead to a relatively rapid outflow of gas moving downward from the point X, at the same time that during upward movement there will be an accumulation of matter until the line of force becomes convex. Thus, in the described situation there can be a transport of matter into the upper part of the forming magnetic loop, an increase in its density and a further outflow along the lines of force forming lateral branches, that is, the formation of a loop prominence.

[196]

## II. METEOROLOGY

### News

#### SYMPOSIUM ON MODELING OF CLIMATIC VARIATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 13, No 5, 1977 pp 563-566

[Article by L. S. Gandin, "Symposium on the Modeling of Climatic Variations (13-22 September 1976, Tashkent)"]

[Abstract] A Soviet-American Symposium on the Modeling of Climatic Variations was held in Tashkent during the period 13-22 September 1976. The symposium was organized by the Main Administration of the Hydrometeorological Service. Thirty reports were presented: 13 American and 17 Soviet. This symposium report very briefly summarizes the content of these reports. For example, L. R. Dmitriyeva told of methods which she has developed for the parameterization of radiant transfer processes which are considerably easier than those used in large American circulation models, but which are the equivalent to them in accuracy. This makes it possible to hope for the successful use of the proposed parameterization in models employed with relatively low-capacity computers. A more detailed radiation model was described by Ye. M. Feygel'son. Its application to the description of climate was discussed. S. S. Zilitinkevich gave a general review of parameterization of the atmospheric boundary layer, paying particular attention to non-stationary boundary layer models, including an equation for the evolution of its upper boundary. The parameterization of the upper layer of the ocean was discussed in a report by D. V. Chalikov. The approach presented in this report is based on universal dimensionless vertical profiles of temperature and salinity in the layer of the seasonal thermocline. Yu. P. Doronin told of numerical modeling of the active layer of the ocean and its ice cover. M. I. Budyko analyzed the influence of the temperature-cloud cover-radiation feedback on conclusions drawn concerning the sensitivity of climate to a change in external parameters. The evaluations made by the speaker indicated that the role of the mentioned feedback is quantitatively relatively small and in the first approximation it can be neglected. L. S. Gandin gave an analysis of the physical hypotheses used in simplified climatic models. S. Ye. Lyapin told of a simplified climatic model based on vertical integration of the heat influx equation.

[106]

## Abstracts of Scientific Articles

### EFFECTIVENESS OF ANTIHAIL WORK IN BULGARIA

Sofia KHIDROLOGIYA I METEOROLOGIYA in Russian Vol 26, No 1, 1977 pp 37-46

[Article by K. Stanchev and P. Simeonov]

[Abstract] A physical-statistical model is used to estimate the effectiveness of antihail operations at two hail-control testing areas (Birdarski Geran in Vratsa Okrug and Gelemenovo in Pazardzhik Okrug) in 1974 and 1975. Monthly loss-energy dependencies are given for both testing areas and the economic recoupment of invested capital is ascertained. It was found that in 1975 34 of 45 cases for Gelemenovo were economically effective and 11 were not (76 and 24% respectively), while at the Birdarski Geran testing area 23 cases were economically effective and 11 were not (68 and 32% respectively). All parameters indicate better effectiveness at Gelemenovo. Barely half the invested capital was recouped in 1975.

[153]

### METHOD FOR DETERMINING ISOTOPIC COMPOSITION OF FALLOUT

Sofia KHIDROLOGIYA I METEOROLOGIYA in Bulgarian Vol 26, No 1, 1977 pp 55-61

[Article by M. Teneva, T. Dimchev and Ya. Prodanov]

[Abstract] A gamma-spectrometer determination was made of the fission products in total monthly samples collected using horizontal plane tables for two years (1974-1975) from 26 stations located in different climatic regions of Bulgaria. A low-background scintillation single-crystal gamma spectrometer was used for the instrumental analysis. The presence of  $^{137}\text{Cs}$ ,  $^{95}\text{Zr} + ^{95}\text{Nb}$ ,  $^{106}\text{Ru} + ^{106}\text{Rh}$  and  $^{144}\text{Ce} + ^{144}\text{Pr}$  was established. The statistical method was used to analyze the gamma spectra. The results indicate that the use of horizontal plane tables to collect radioactive fallout makes it possible to determine not only the total induced beta activity, but also the distribution of radionuclides in the monthly samples. The low-background gamma-spectrometric method permits the nondestructive determination of the activity of gamma-active fission products in the monthly

fallout. The seasonal course of the monthly fallout activity of the investigated radionuclide-fission products can be established. The seasonal distribution is due to transport processes (from the stratosphere to the troposphere) and atmospheric circulation. A reliable linear correlation was established between the monthly fallout activity of  $^{106}\text{Ru} + ^{106}\text{Rh}$  and monthly precipitation and therefore the washing out of this radionuclide from tropospheric air by precipitation is more important for its fallout. [153]

#### ANALYTICAL REPRESENTATION OF INTEGRAL CLOUD TRANSMISSION FUNCTION

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 13, No 5, 1977 pp 505-514

[Article by L. D. Krasnokutskaya and T. A. Sushkevich, Institute of Applied Mathematics and Institute of Atmospheric Physics, "Analytical Representation of Integral Cloud Transmission Function"]

[Abstract] The attenuation of IR solar radiation in the cloud-filled atmosphere, as a result of the absorption by gaseous and droplet water, due to the line structure of the absorption spectrum of water vapor for finite spectral intervals, is described by means of nonexponential transmission functions. An analysis is made of this function,  $\mathcal{P}_{\text{int}} \equiv P(m_v, m_w)$ , where  $m_v$  is the reduced mass of water vapor (in  $\text{g/cm}^2$ ) and  $m_w$  is the effective absorbing mass of droplet water. First the authors obtain a representation of  $P(m_v, m_w)$  in the form of the sum of exponents for one of the arguments with fixed values of the second argument. Then the coefficients themselves are approximated using the second argument. The method of minimizing a quadratic functional is used in determining the most probable values of the parameters of the analytical expression approximating the function stipulated in a finite discrete set of points. The minimum of the functional is found by the linearization method. The computations were made using the "Approximatsiya" program described in the literature. [106]

#### KINETICS OF CONDENSATION-COAGULATION PROCESSES IN ATMOSPHERE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 235, No 1, 1977 pp 50-52

[Article by V. M. Voloshchuk and Yu. S. Sedunov, Institute of Experimental Meteorology, "Kinetics of Condensation-Coagulation Processes in the Earth's Atmosphere"]

[Abstract] Analyses of different peculiarities of condensation-coagulation processes transpiring in the atmosphere during the formation and development of liquid-drop clouds were presented in earlier studies by the authors.

As shown in this article, these and other investigations make it possible to formulate in quite general form a kinetic equation which describes the evolution of the microstructure of liquid-droplet clouds in the turbulent atmosphere. Such an equation can be used both in the mathematical modeling of artificial modification of the microstructure of cloud cover by different methods and in the development of some methods for predicting definite weather phenomena (such as precipitation), taking into account the evolution of the microstructure of clouds in nonparametric form. The article gives the derivation of a fundamental equation for describing the kinetics of condensation-coagulation processes in the turbulent atmosphere. This equation evidently is not suitable for describing the investigated processes at some initial moment of time and in thin layers at the boundaries of the cloud medium. These difficulties can be eliminated in the solving of specific problems by an appropriate reformulation of the initial and boundary conditions.

[173]

#### TRANSMISSION OF SOLAR RADIATION BY TRADE WIND ZONE CLOUD COVER

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, GEOGRAFIYA in Russian No 1, 1977  
pp 89-92

[Article by A. V. Kislov, Department of Climatology and Meteorology, Moscow University, "On the Problem of the Transmission of Solar Radiation by Trade Wind Zone Cloud Cover"]

[Abstract] The article examines some results of measurement of the transmission of IR radiation (transparency window  $8-13\mu\text{m}$ ) by thin clouds for a period during GATE-74 aboard the scientific research ship "Akademik Kurchatov." The measurements were made using a MDR spectrometer tuned for discriminating in the flux of direct solar radiation that radiation having a wavelength of  $10.0\mu\text{m}$ . These observations were accompanied by the registry of direct integral solar radiation using a standard Yanishevskiy actinometer. For ensuring precise pointing on the sun the instruments were attached in a special tracking system for compensating the rolling of the ship. Registry of signals from the radiation sensors was with EPP-09 recorders. The measurements were made in the near-midday hours with atmospheric masses varying from 1.00 to 1.09. Atmospheric transparency during the observations did not change greatly. In processing the measurements specialists determined the transmission and optical density of cumulus, altocumulus and cirrus clouds. Figure 1 shows the distribution of the frequency of recurrence of transmission of monochromatic radiation by cumulus, altocumulus and cirrus clouds. Table 1 gives the statistical characteristics of the distribution of the frequency of recurrence of the transmission of direct solar radiation by clouds of different types. Table 2 gives the polydisperse coefficient of attenuation of radiation for different models of cumulus and cirrus clouds. All these data are analyzed. For example, it was found that the optical density of an

atmosphere with altocumulus clouds can increase in comparison with a cloudless sky by 40-100%. Cirrus clouds increase the optical density of the equatorial atmosphere by an average of 180%.  
[191]

#### EFFECT OF TEMPERATURE STRATIFICATION ON CLOUD CONVECTION

Sofia KHIDROLOGIYA I METEOROLOGIYA in Bulgarian Vol 26, No 2, 1977 pp 15-22

[Article by S. Stoyanov and P. Boev]

[Abstract] A jet cloud convection model is used in analyzing the effect of the temperature stratification on the profile of an up-current in a convective cloud, as well as on the vertical velocity in the cloud and the convection level. Two equations of the system for describing the cloud jet are considered in detail, that is, the equation for variation of vertical velocities with altitude and the equation for the vertical gradient of air temperature in a cloud. Model calculations are made of the thermodynamic characteristics of clouds with a vertical development from 23 situations with powerful convection in the western part of the Thracian lowlands. Use is made of data from aerological soundings carried out at the Gelemenovo hail-control testing area. Radar observation data are used to compare the calculated convection levels with the actual ones. Processes within the cloud mass are shown to be related to the temperature stratification in the free atmosphere. The jet cloud convection model can be used to expand hail research.  
[199]

#### EFFECT OF TURBULENT INTENSITY OF CURRENTS ON BOTTOM-LIMIT NONSCOURING VELOCITIES

Sofia KHIDROLOGIYA I METEOROLOGIYA in Bulgarian Vol 26, No 2, 1977 pp 29-39

[Article by G. Kr. Gadzhev]

[Abstract] Theoretical and experimental studies indicate that the turbulent intensity of the currents in the bottom area affects the limit equilibrium of a sand bed. The bottom-limit nonscouring velocities diminish in value with an increase in the turbulent intensity and vice versa. When this index varies from 0.10 to 0.35, the bottom-limit nonscouring velocity varies from  $V_{b \text{ lim}} = 46 \sqrt{e'd}$  to  $V_{b \text{ lim}} = 34 \sqrt{e'd}$  or from 0 to 35%. The formula  $V_{b \text{ lim}} = 53.6 \sqrt{e'd} / (1 + 1.65 \tau_b)$  is given to calculate the limit nonscouring velocities in uniform currents with any turbulent intensity value in the bottom area. A categorization of turbulent currents with respect to  $\tau_b$  is suggested, this being used to calculate bottom-limit nonscouring

velocities when there are no specific measurements. It is established that the Froude number calculated for the limit bottom pulsation velocity has a constant value regardless of the indices of the bed and current. It is essentially a criterion of the limit equilibrium of a sand bed under turbulent conditions in a current with different turbulent intensities. The dependence  $M_x = M_{99} - (\Delta \tilde{V}/V_{\text{mean}}) \cdot 1/\zeta$  is established to calculate the pulsation velocity probability. This is used to establish that the pulsation velocities at the moment of limit equilibrium have the probability  $P = 90\%$ . Some of the principal states of sand beds are considered as a function of the variation in pulsation velocities according to the limit velocities for the corresponding mobile bottom. The following analytic dependence is given for the maximum pulsation velocities for the limit equilibrium state and limit absolute rest:

$$\Delta \tilde{V} = V_{b \text{ lim}} - V_{b \text{ r}} + M_{99} \zeta (V_{\text{mean lim}} - V_{\text{mean r}}),$$

where  $V_{b \text{ r}}$  is the bottom velocity for the limit absolute rest,  $V_{\text{mean lim}}$  is the mean velocity in the vertical at the limit state of equilibrium, and  $V_{\text{mean r}}$  is the mean velocity in the vertical at limit absolute rest.  
[199]

#### LONG-TERM CYCLICITY OF CIRCULATION CHARACTERISTICS

Berlin ZEITSCHRIFT FUR METEOROLOGIE in Russian Vol 27, No 1, 1977 pp 35-42

[Article by S. S. Savina and L. V. Khmelevskaya, Geography Institute USSR Academy of Sciences, "Investigations of Long-Term Cyclicity of Circulation Characteristics"]

[Abstract] This paper deals with the results of the use of a large-scale classification of elementary circulation mechanisms for the investigation of cycles in the long-term duration of the seasonal behavior of circulation (early spring, summer, autumn, early winter, winter) in the northern hemisphere. The paper is further concerned with the study of variations of circulation and climate in smaller territories. A new principle is proposed for the standardization of elementary circulation mechanisms which links regional atmospheric processes with macroscale processes.

[158]

### III. OCEANOGRAPHY

#### News

#### REPORT ON UNDERWATER RESEARCH IN LAKE BAYKAL

Moscow IZVESTIYA in Russian 14 Jul 77 p 6

[Article by L. Shinkarev, "Exploration in Baykal"]

[Text] After three days of voyaging in the southern waters of Baykal and near the source of the Angara, the "G. Yu. Vereshchagin," scientific vessel of the Limnological Institute, Siberian Department USSR Academy of Sciences, has returned to port. It has been engaged in the exploration of the sectors most suitable for submergence and work of the deep-water vehicles "Payssis." After studying the data obtained on the voyage concerning bottom relief and the magnetic field, the region selected for the first dives was two kilometers from Cape Listvenichnyy, where the depth is more than a kilometer.

Marine geophysicists are satisfied with the test voyage. The ocean equipment used here for the first time yielded rich and in many respects new information concerning the peculiarities of this sector of the basin. In the region planned for the first joint experiment of the underwater research ship and deep-water manned vehicles, the shore slope of the lake is steep and locally is a vertical wall consisting of ancient rocks whose age is about two billion years. These ancient rocks were shoved outward here, and beneath the waters of Baykal. It is an attractive idea to take samples of them, to document the principal rock complexes making up the basement of the Siberian platform, to study the cross section as a whole. And possibly here one can encounter shows of young igneous rocks, fresh fissures and ancient strata.

The local population is very familiar with the tectonic movements of the earth's crust because of the earthquakes which are rather frequent here, which on the average of once each 7 1/2 years attain an intensity of seven to ten scale units. The earthquake of 1862 became legendary. At that time an extensive steppe disappeared underwater in the neighborhood of the delta. On this steppe there were four Buryat villages and Proval Gulf was formed here.



The activity of the deep layers is also indicated by the more than 30 mineral springs emerging from the depths of the earth at its surface, primarily hot springs (up to 100° Celsius), and the high heat flux in this area, emanating from the depths, whose source for the time being is unknown. In any case, the director of the Limnological Institute, Corresponding Member USSR Academy of Sciences G. Galaziy, hopes that precisely the submergence of research underwater vehicles with scientists aboard will help, among other things, in studying new geological structures and the mechanism of the escape of deep heat on the bottom of the lake.

"We know virtually nothing about the vertical mixing of water at great depths and what role turbulent currents play in the distribution of bottom organisms," says G. Galaziy. "If we succeed in studying this, new data can be obtained for evaluating the direction and rates of evolution of water organisms in Baykal."

More and more detachments of oceanologists are arriving at Listvennichnoye. Great hopes here are being laid on the seismic profiling and seismic sounding which will be carried out in the lake for the first time. Up to now it has not been possible to make precise measurements of the sediments in the basin. The patterns of distribution of bottom sediments, their structure, true thickness to the basement and samples of bottom sediments can to some degree cast light on disputable matters regarding the development of the Baykal depression -- indeed, marine apparatus is capable of giving an unambiguous answer to many questions.

At the shipbuilding berths at Listvennichnoye Baykal ships are ending reoutfitting with a special carrier barge which will carry a 16-ton crane and which will transport the "Payssisy" for distant transport trips. After submergence in the southern part of the lake plans call for investigating the region adjacent to Ol'khon Island. Near this mountain range, rising above the water after active movements of the earth's crust, the greatest depths are observed.

The chief of the complex expedition on Baykal, the oceanologist Ye. Mirlin, states: "In the Atlantic scientists have obtained important results relating to the mechanism of formation of a new oceanic crust. It is now attractive to compare the processes of tectonic movements in the already mature ocean and here, in what are postulated to be the initial stages in the formation of the ocean itself."

In the opinion of scientists, these studies are important for more than theoretical reasons. The formation of minerals is associated to some degree with the rift zones where one crust is formed and another is destroyed.

The "Payssisy" are virtually ready for work. The hydronauts recently have been checking the joints and seams of the steel hulls, on-board instrumentation, system for collecting data from the sensors measuring

the principal parameters of the water medium. These data are recorded on the videomagnetic recorder aboard the vehicle jointly with an image. These are in coded form convenient for subsequent processing on an electronic computer. The dives in Baykal have been entrusted to high-class hydronauts -- A. Podrazhanskiy, V. Brovko, A. Sagalevich and their young comrades -- A. Rulev, A. Gorlov and S. Fokin... Earlier they have not submerged below 700 meters and now they must dive to depths which until now they have not experienced. The workers will include a group of Irkutsk aqualung-equipped limnologists headed by N. Reznikov.

[183]

#### RESEARCH SUBMARINES USED TO STUDY LAKE BAYKAL

Moscow IZVESTIYA in Russian 3 Jul 77 p 4

[Article by L. Shinkarev, "Will Baykal Become an Ocean?"]

[Excerpt] The other day passengers at the Irkutsk airport observed how a giant "Antey" aircraft, rare in these skies, noisily landed and how one after another two red and white steel vehicles, outwardly resembling helicopters, but without their propellers, rolled through its doors onto the airstrip. The inscriptions on their sides, "Payssis-7" and "Payssis-11," only for those "in the know" designated the type of deep-water research submarines of the Institute of Oceanology imeni P. Shirshov USSR Academy of Sciences. And to the random witnesses of their transport to Siberia from the Black Sea it could not occur that precisely these underwater vehicles (length 7 meters, weight 11.5 tons) will assist in some degree in checking the hypothesis that Baykal in distant geological eras may become a sea or even an ocean.

It required the research of several generations of scientists who investigated the ancient "crown" of Asia, as the mountainous country adjacent to Asia is called, and there were long disputes concerning the nature of the local geological processes, before clear indications of present-day movements of the earth's crust on these shores gave basis for listing the lake in the ranks of the world system of rift zones. It is possible that at the bottom of Baykal a new crust is being formed, a crust such as now underlies the bottom of existing oceans. It is assumed that the lake shores are advancing outward each year at the rate of two centimeters. The custom of Siberians to call Baykal the "glorious sea" after tens of millions of years may cease to be an exaggeration.

The complex investigations on and in Baykal will be carried out by the scientific institutes of the Siberian Department USSR Academy of Sciences, especially the Limnological Institute, located in the village of Listvennichnyy, on the lake shore, and also the Institute of Oceanology USSR Academy of Sciences. The underwater vehicles were delivered to Listvennichnyy on two truck trailers.

More than ten tons of equipment arrived together with them. This had been tested during the sea voyages of the scientific research ship "Akademik Kurchatov." They have been placed aboard the ship used by Siberian limnologists, the "G. Yu. Vereshchagin," which is ready for voyages into the southern and central regions of Baykal, where scientists are carrying out a geophysical survey. It is precisely the geophysicists who will suggest where the "Payssisy" will head.

The marine geophysicist A. Shreyder concludes his story in the following way: "Baykal is a highly interesting tectonic fault. By investigating it we will be able to add new pages to the history of the world ocean."

Spreading at our feet is Baykal, a water body with a distinctive flora and fauna, which holds about a thousand species of living objects, no longer found elsewhere, a great natural laboratory where even now some species are forming and others are dying out. On our planet there are few such centers of species formation and when the lovers of Siberian nature raise their voices in defense of the water body they are concerned not only to preserve the unique transparency of this water, but first and foremost -- to save a unique medium which arose millions of years ago.

Limnologists with aqualungs have dived into the depths of Baykal for 40-50 meters. But one bold fellow, a Siberian human fish, at his fear and risk descended to 96 meters. Below the water grew dark and was impermeable for the human eye. The "Payssisy" underwater vehicles are capable of descending to virtually any depths in the lake (the deepest depression in Baykal is near Ol'khon Island -- 1,620 m) and will open to the view of researchers the actual picture of ecological conditions.

In any case, Siberian ichthyologists, accustomed to deal with traditional instruments controlled from aboard a ship, in one way or another moving during the rising of bottom and surface layer organisms and distorting the true picture, now are greedily looking at the beautiful submarines standing before them on aluminum skis and ready for submergence.

The "Payssisy-7" and "Payssisy-11" deep-water vehicles have recommended themselves well in test dives in the Black Sea and have been specially re-equipped for work in fresh Baykal water. The director of the group of underwater manned vehicles of the Institute of Oceanology, the experienced diver A. Podrazhanskiy, and his friends are outfitting boats with photographic and television cameras, manipulators capable of collecting from the bottom samples having a weight up to 100 kilograms.

The hydronauts (they are also called pilots), undergoing training in vehicles of this type in Canada, where they are fabricated, and in the Black Sea, are not too willing to have guests aboard, climbing up the aluminum ladder by which they may board the "Payssisy." But those who are so favored see a manned sphere with two divans and a folding-back table where two or three men can sit. Two men lie on divans with their faces toward the

window. A third, at the table, has his head on a pillow. Then the three of them together turn on the outside searchlights which give a field of view of 180 degrees.

Only a few days remain before the first dives.

\*\*\*

Commentary by Corresponding Member USSR Academy of Sciences A. S. Monin, Director of the Institute of Oceanology.

"The principal purpose of our complex expedition is to clarify the fundamental possibility of studying Baykal as a rift zone. In other words, to find out if Baykal belongs to the new global tectonics or the tectonics of plates. According to these modern points of view, the upper seismically active layer of the earth is divided into stable sectors -- gigantic atmospheric plates. There are six or seven such plates and some of them are divided into smaller plates. Some of the boundary regions of the plates are rift zones which most frequently are bottom mid-oceanic ridges."

"These rift zones 'live'; among them are old ones and young ones, growing ones and contracting ones. Baykal, as we assume, is situated in the very initial stage of development, if it is regarded as a rift zone. Possibly it will remain such and possibly it will begin to grow. And if we actually (and there is great hopes for this) discover on the floor of Baykal evidence of an oceanic rift zone, or something similar to it, then we will be able not only to establish reliably the history of formation of the lake, but we will also make a major contribution to the development of the modern theory of the earth's structure."

"I hope that the Irkutsk scientists, for the first time having the opportunity, due to the organization of the complex expedition, to use modern equipment which oceanology now has at its disposal, will strive to use it to the maximum. I think that considerable scientific discoveries are ahead of us."

[163]

## Abstracts of Scientific Articles

### COMPUTING FINE STRUCTURE OF DENSITY AND VELOCITY FIELDS

Moscow OKEANOLOGIYA in Russian Vol 17, No 3, 1977 pp 389-393

[Article by A. I. Leonov, Yu. Z. Miropol'skiy and R. E. Tamsalu, Institute of Mechanical Problems, Institute of Oceanology and Baltic Scientific Research Institute of Fisheries, "Computing the Fine Structure of the Density and Velocity Fields (in the Example of the Baltic Sea)"]

[Abstract] Earlier studies (Yu. D. Borisenko, et al., IZV. AN SSSR, FIZIKA ATMOSFERY I OKEANA, 12, No 3, 1976; A. G. Voronovich, OKEANOLOGIYA, Vol 16, No 5, 1976) defined a theory of propagation of nonlinear packets of internal waves in a stratified fluid. In these studies it was demonstrated that during propagation of a wave packet, due to nonlinear interactions, mean velocity and density fields are formed in the fluid; these fields are proportional to the square of the amplitude of the internal wave. The vertical structure of these fields can have fine inhomogeneities, which will make it possible to explain the origin of the fine structure of hydrophysical fields in the ocean. Voronovich, et al. also analyzed the equations describing such a fine structure and also cited examples of analytical computations for different models of an undisturbed ocean stratification. This new article gives numerical computations of the fine structure of the velocity and density fields for a real distribution of undisturbed density in the Baltic Sea. The results of the computations are compared with available experimental data.

[192]

### DISPERSION EXPRESSIONS FOR GRAVITATIONAL AND ROSSBY WAVES

Moscow OKEANOLOGIYA in Russian Vol 17, No 3, 1977 pp 394-399

[Article by V. M. Kamenkovich, V. I. Ul'yanova and T. B. Tsybaneva, Institute of Oceanology, "Dispersion Expressions for Gravitational and Rossby Waves in the Ocean"]

[Abstract] This paper is essentially a continuation of earlier papers by V. M. Kamenkovich and T. B. Tsybaneva (OKEANOLOGIYA, Vol 15, Nos 2 and 3, 1975). Now the authors propose a numerical method for computing the eigenvalues of Laplace tidal equations for large wave numbers. The article gives a comparison of the eigenvalues determined using asymptotic formulas and numerically, revealing the correctness of the asymptotic formulas. On the basis of the asymptotic formulas it was possible to construct dispersion curves for gravitational and Rossby waves on a rotating sphere.  
[192]

#### MEANDERING OF THE CROMWELL CURRENT

Moscow OKEANOLOGIYA in Russian Vol 17, No 3, 1977 pp 417-420

[Article by V. B. Titov, Southern Division Institute of Oceanology, "Meandering of the Cromwell Current"]

[Abstract] The meandering of the equatorial currents is examined from the point of view of the theory of inertial movements near the equator. Also given are new experimental data on the meandering of the Cromwell Current. The author evaluates the parameters of the meanders in the equatorial zone and establishes the relationship between the phase of the meander and the change in the current velocity modulus. The data were collected during the 51st voyage of the research vessel "Vityaz'," during which five meridional profiles were run across the equator from 151 to 175°E. According to data along 166.5°E, the approximate parameters of the meanders (wave period and length) were:

Latitude	2.5°N	1.5°N	0°	1.5°S	2.5°S
Period (days)	7	10	12	9	7
Wavelength (miles)	420	500	510	440	370

The cited data show that the periods change appreciably with latitude. In addition, at identical latitudes on both sides of the equator the periods approximately coincide. The lengths of waves at symmetric latitudes, however, differ somewhat due to the lower velocities to the south of the equator.

[192]

#### OPTIMUM CONDITIONS FOR TOWING OF MAGNETOMETER

Moscow OKEANOLOGIYA in Russian Vol 17, No 3, 1977 pp 549-551

[Article by A. A. Shreyder, Institute of Oceanology, "Evaluation of Optimum Conditions for Towing of Magnetometer"]

[Abstract] In an experiment in the Indian Ocean the author obtained deviation curves for a towed proton magnetometer for cables with 0.25, 1.5, 2 and 2.75 ship's lengths. The measurements were made in eight principal directions. In all cases the maximum value of the amplitude of deviation corresponded to a south-north direction. The deviation was 688, 150, 75 and 10 gammas respectively. It was established experimentally that for modern oceanic fully metal ships the magnetometer deviation becomes insignificant with the sensor at a distance from the stern close to three ship lengths. Thus, it was shown that there is a possibility of making surveys with large fully metal vessels in shallow waters when using short cables.

[192]

#### ACOUSTIC METHODS FOR REGISTRY OF SURFACE WAVES

Moscow OKEANOLOGIYA in Russian Vol 17, No 3, 1977 pp 544-548

[Article by V. I. Volovov and V. V. Krasnoborod'ko, Acoustics Institute, "New Acoustic Methods for the Registry of Surface Waves"]

[Abstract] The authors examine three acoustic methods for determining the height of waves which were developed applicable to basin conditions and which were used in carrying out model experimental studies for investigating the reflection of sound from a wave-covered water surface for monitoring wave parameters. In the first the ultrasound source and detector are designed in the form of two piezoceramic tubes of different diameter and these are mounted coaxially in a cylindrical metal housing. The design is simple, reliable and economical, but its response and speed are relatively low and the distortions introduced by it into the high-frequency part of the waves can be considerable. Therefore, this method is most effective in the registry of the slowly changing fluid level. The second method is essentially free of these shortcomings. The detector of ultrasonic oscillations of a cylindrical type is oriented vertically on the discontinuity of the two media and a spherical source is submerged directly beneath it. The detector is a piezoceramic cylinder 3.7 mm in diameter and 50 mm in height and its internal cavity is filled with air. The source is a sphere with a diameter of 10 mm and is situated at a depth of 50 cm. This is a phase method and therefore is very sensitive and is suitable for the registry of waves with a small amplitude. However, the presence of a detector at the discontinuity introduces a distortion into the waves themselves. The third method assumes the placement of a spherical detector near the wave-covered surface of the fluid. The ultrasonic source and detector are spheres with a diameter of 10 mm. The depth of submergence of the detector is 4.1 cm and the depth of the source is 50 cm. Acoustic wave sensors, in comparison with string electrode sensors, have the advantage that they can be more sensitive to small level changes, do not require regular calibration, can be used in fluids with any conductivity and the last of the methods is virtually inertialess.

[192]

## INCREASING THE ACCURACY OF CURRENT COMPUTATIONS

Moscow OKEANOLOGIYA in Russian Vol 17, No 3, 1977 pp 421-426

[Article by V. A. Makarevich, "Increasing the Accuracy of Current Computations"]

[Abstract] In order to increase the accuracy of computation of gradient currents in the ocean, the author uses spline polynomials instead of finite differences. In the example of computing the gradient component of velocity of the surface current in the Pacific Ocean, the article gives a comparison of these methods and it is shown that the values of the level gradients changed on the average by 30-40% with a changeover from finite differences to spline polynomials. The decrease in the error in computing gradients from known functions makes possible a more precise computation of currents in the ocean.

[192]

## VARIATIONS IN EMISSIVITY OF WATER SURFACE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 13, No 5, 1977 pp 551-554

[Article by A. K. Gorodetskiy and A. P. Orlov, Institute of Atmospheric Physics, "Variations of Emissivity of Water Surface"]

[Abstract] A study was made to determine variations in the emissivity of a water surface on the basis of experimental data. For this purpose the authors used the results of measurements of the angular distribution of the radiation of a water surface and atmospheric backscattering in the spectral region 10.5-12  $\mu\text{m}$ . The measurements were made using a radiometer in the tropical zone of the Atlantic Ocean. It was found that when the ocean surface is covered with waves of class 3-4 and the wind velocity is 5-10 m/sec the emissivity of the ocean surface varies in the range 0.972-0.992 in dependence on the intensity and angular distribution of atmospheric backscattering. Under these conditions the mean increase in emissivity due to the characteristic radiation of the ocean in comparison with the radiation of the non-wave-covered surface is 1.3% and the contribution of reflected atmospheric radiation varies in the range 1.2-3.2%. The mean contribution of the characteristic radiation of the ocean surface in the tropical zone of the Atlantic Ocean to emissivity is 0.96 and the corresponding difference between the kinetic and effective temperature of the radiation in the hemisphere is 2.7°K.

[106]



## EXPLORATION AND EXPLOITATION OF NATURAL GASES AT SEA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 5, 1977 pp 21-31

[Article by N. V. Cherskiy and V. P. Tsarev, Institute of Physical-Technical Problems of the North, "Evaluation of the Resources and Problems of Search For and Extraction of Natural Gases from Sediments of the World Ocean Floor"]

[Abstract] The results of study of the mechanism of accumulation of biochemical methane in zones of hydrate formation make it possible to assume that the reserves of natural gas in the world ocean (layer of sediments with a thickness up to 300 m) are several orders of magnitude greater than the resources of hydrocarbons on the continents. The modern level of development of technology makes it possible to expand work on the search for and extraction of natural gases from sea sediments on a broad scale. The article describes in detail the mechanism of accumulation of biochemical gases in zones of hydrate formation, followed by an approximate evaluation of the error in computations of resources of gas and the magnitude of the reserves. A proposed research program is outlined.  
[197]

## ORGANIC CARBON IN BOTTOM SEDIMENTS OF CHUKOTSK SEA

Kiev DOPOVIDI AKADEMIYI NAUK UKRAYINS'KOYI RSR in Ukrainian SERIYA B, GEOLOGICHNI, KHIMICHNI TA BIOLOGICHNI NAUKY No 6, 1977 pp 483-486

[Article by M. O. Belov, V. I. Ogorodnikov and O. Yu. Mitropol'skiy, Arctic and Antarctic Scientific Research Institute and Institute of Geological Sciences Ukrainian SSR, "Organic Carbon in Bottom Sediments of the Chukotsk Sea"]

[Abstract] Investigations were made which made it possible to ascertain ways in which organic carbon enters bottom sediments and ways in which it is further transformed due to the primary stages of oil formation and the diagenesis of sediments. Schematic maps were compiled showing the distribution of organic carbon and the degree of bituminosity in the bottom deposits of the Chukotsk Sea. Data for 13 stations are presented. A table breaks down the results for different types of bottom material.  
[170]

## PROSPECTS FOR PETROLEUM AND GAS IN INDIAN OCEAN

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 5, 1977 pp 72-77

[Article by A. P. Milashin, A. A. Terekhov and L. Ya. Shvarts, Southern Marine Geological Trust, and R. D. Rodnikova, Scientific Research Laboratory of Foreign Geology, "Prospects for Petroleum and Gas in Sedimentation Basins on the Periphery of the Indian Ocean"]

[Abstract] Geological-geophysical investigations carried out in the Indian Ocean (with the use of data for the coastal sectors of the land and deep-water drilling) make possible a rough approximation of the principal patterns of changes in rock thicknesses and to compare deposits with sedimentary complexes of the shores and to discriminate sedimentation basins which are promising with respect to petroleum and gas. Figure 1 in the text shows these sedimentation basins. The individual basins are discussed in detail. The text indicates that the peripheral downwarps of the Indian Ocean, especially the basins of the Arabian Sea and Southeast Asia, are of great practical interest in the quest for petroleum and gas. These basins contain more than 150 billion tons of hydrocarbons, of which more than 20% are in sectors with sea depths less than 500 m.

[160]

## SYSTEMATIC AND RANDOM ERRORS IN DETERMINING SHIP POSITION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA in Russian No 2, 1977 pp 37-43

[Article by A. I. Galoshin, Central Scientific Research Institute of Geodesy, Aerial Mapping and Cartography, "Systematic and Random Errors in Determining Ship Position"]

[Abstract] In carrying out a topographic survey of the shelf particular attention must be given to the accuracy in determining the position of the survey ship. In determining the most probable position of the vessel it is necessary to take into account the influence of both random and systematic errors on the measurement results. Accordingly, the author gives a method for rigorous allowance for the influence of systematic and random errors in determining the position of a ship in the case of an excess number of measurements. Also examined are different combinations of the joint influence of systematic and random errors in ascertaining position. A numerical example is presented.

[172]

## EVOLUTION OF THE HYDROSPHERE AND OCEAN LEVEL

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, GEOGRAFIYA in Russian No 2, 1977  
pp 51-57

[Article by R. K. Klige and V. A. Shleynikov, Institute of Water Problems,  
"The Problem of Evolution of the Hydrosphere and Ocean Level"]

[Abstract] The earth's hydrosphere is one of the most ancient shells of our planet and probably developed about 4.0-3.5 billion years ago. At the present time about 2,000 sea stations are making systematic observations of the changes in ocean level. Analysis of these materials for 1,140 stations shows that during the last 250-300 years there have been long-term periodic increases in sea level (averaging  $\pm 3-4$  cm) approximately each 33 years, transpiring against a background of an undeviating increase in the water surface. The total mean increase in the level surface of all seas and oceans in the current century is occurring at the mean rate of 1.5 mm per year. The most intensive rise in level was observed during the period from 1924 through 1948, when its rate attained about 3 mm per year. After the 1940's the rate of rising of the ocean level decreased somewhat, but the rise is continuing even now. The present-day increase in the level of the world ocean is closely associated with the general warming of the earth's climate, melting of the glacial cover, reduction in the reserves of surface and ground water. Analysis of materials on the history of the earth and the nature of change in water exchange shows that major changes in the level of the world ocean, transpiring on scales from a century to tens of thousands of years, for the most part are determined by relatively rapidly transpiring processes of water exchange. However, already in the limits of hundreds of thousands and millions of years the key factors determining the variations in ocean level are the geological processes, against whose background rapidly transpiring hydrometeorological phenomena develop.  
[190]

#### IV. TERRESTRIAL GEOPHYSICS

##### News

#### BELOUSOV COMMENTS ON INTERNATIONAL GEOPHYSICAL RESEARCH

Moscow IZVESTIYA in Russian 1 July 77 p 5

[Article by V. Belousov, "Time for Great Discoveries"]

[Summary] This is the twentieth anniversary of the International Geophysical Year and V. Belousov, Corresponding Member USSR Academy of Sciences, Chairman of the Interdepartmental Geophysical Committee, has taken the opportunity to review the importance of the IGY and the IQSY which followed it, then moving on to the current international research programs of which these were forerunners. It can now be said that international projects involve all natural processes transpiring in the earth, on its surface and near it in space. Not one major geophysical investigation, especially in the atmosphere or ocean, would be conceivable without the joining of scientists from different countries. After the IGY was over there was exceptional activity of the international scientific unions and UNESCO. Scientists from throughout the world are now meeting regularly for the exchange of results and ideas. Antarctica became an arena of international cooperation. This gave rise to a political agreement that this continent would become a scientific reservation open for all world scientists. Soviet scientists were always at the forefront of the movement for cooperation. They participated in the organization of the IGY and were very active in implementing its programs. They were the initiators of many subsequent important international projects; they have headed international scientific unions, associations, committees and commissions. The Soviet Union has sent out geological-geophysical expeditions for studying the geological structure of the earth's crust in East Africa and Iceland. Soviet scientists in their international activity proceed with the assurance that the spirit of international cooperation in scientific research is creating an atmosphere favoring greater scientific attainments.

[154]

## NOTES ON EARTHQUAKES AND CLIMATIC CHANGE

Moscow TEKHNIKA MOLODEZHI in Russian No 6, 1977 pp 14-16

[Article by Vladimir Mosinets, Nikolay Prikhod'ko and Boris Kononov, "Controlling the Forces of Nature or How to Predict Earthquakes and Improve Climate at the Same Time"]

[Summary] The authors feel that it is possible to contend with earthquakes. This is at least true of their unexpected nature. They contend that there is nothing to interfere with the artificial relaxation of underground stresses. Before such work was done it would be necessary to cut off electric and gas systems and other types of communications, make petroleum and gas storage units safe, evacuate the population and remove material goods. Such a possibility is due, in their opinion, to the successes of the modern physics of solid bodies and the theory of elasticity. A model can be developed of the accumulation of elastico-plastic energy and it would be possible to control this process at any stage in its formation. All this can be done by means of powerful artificial explosions. At the same time, it is possible to correct the "errors of nature" in the distribution of climatic zones. The authors review a number of the proposals which have been presented in the literature along these lines: some of them are for increasing the temperature of the sea or land, whereas others are for reducing it. [In commenting on this article, Aleksandr Shcherban', Academician Ukrainian Academy of Sciences, stated in part as follows: The authors touch on two important problems. First, they analyze the process of accumulation of mechanical stresses in rocks; they propose by means of powerful explosions to relax in time the forming focus of an underground cataclysm or to bring the crustal matter in a stressed state into a critical stage, that is, artificially induce a controllable earthquake. The rich experience accumulated by world practice in the field of use of underground explosions gives basis for considering this idea to be entirely realistic. Second, the authors propose to use such explosions for changing the relief of the sea floor in order to intensify or lessen the inflow of warm or cold current waters, that is, to improve climate. However, neither of these projects can be carried out without first implementing a complex of scientific investigations and without careful study of the effects.]

[146]

### Abstracts of Scientific Articles

#### MODELING OF WAVE PROPAGATION IN RADially INHOMOGENEOUS MODEL OF EARTH

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 235, No 1, 1977 pp 46-49

[Article by Corresponding Member USSR Academy of Sciences A. S. Alekseyev and B. G. Mikhaylenko, Computation Center Siberian Department USSR Academy of Sciences, "Numerical Modeling of Processes of Seismic Wave Propagation in Radially Inhomogeneous Model of Earth"]

[Abstract] New possibilities for quantitative analysis of wave fields in inhomogeneous media are appearing with a combination of the analytical method for incomplete separation of variables and finite-difference methods. For an inhomogeneous elastic half-space such an approach was developed by A. S. Alekseyev, et al., DAN, Vol 214, No 1, 1974, and A. S. Alekseyev, et al., IZV. AN SSSR, SER. FIZIKA ZEMLI, No 12, 1976. In this article the method is used for computing the total wave field from point sources situated in a radially inhomogeneous elastic sphere. The idea of the method involves a decrease in the dimensionality of the problem in space by means of the separation of variables and subsequent solution of the reduced problem of lesser dimensionality by finite difference methods. [173]

#### METHOD FOR DISCRIMINATING THE NORMAL GEOMAGNETIC FIELD

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 3, 1977 pp 512-515

[Article by G. I. Pil', "One Method for Discriminating the Normal Geomagnetic Field"]

[Abstract] The article describes a method for discriminating the normal field from observations of a quite detailed field by means of its scaling aloft and subsequent transformation of the discriminated field onto the earth's surface using an analytical field model. In the considered method there are two considerations involved: determination of the altitude at which an anomaly of a particular class disappears and transformation onto the earth's surface from this altitude. Two methods are examined which make it possible to determine the altitude at which anomalies disappear:

using direct computations by the Poisson formula and on the basis of an evaluation of the integral in this formula. It is shown that the proposed method makes it possible to discriminate the normal field with a systematic error 10-30 times less than the error in the analytical field model.  
[159]

#### CHANGE IN THE INTENSITY OF OSCILLATIONS WITH DEPTH

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR, SERIYA FIZIKO-TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 2, 1977 pp 115-117

[Article by Dzh. Garagozov, Institute of Physics of the Earth and Atmosphere, Turkmen Academy of Sciences, "Change in the Intensity of Oscillations with Depth"]

[Abstract] The velocity of seismic oscillations is inversely proportional to the density of the medium and the velocity of propagation of seismic waves. Density and velocity of propagation increase with depth from the earth's surface, which leads to a decrease in the velocity of the oscillation. The author made measurements of the intensity of oscillations in a shaft. The material from which the shaft was made consisted of pebbles. VEGIK and GB-III seismographs with galvanometric registry were used for clarifying the influence of depth on the intensity of seismic oscillations. The oscillations were recorded at two levels: at the base of the shaft and at the surface. On the basis of the earthquake records it was possible to construct amplitude-frequency curves characterizing oscillations at the surface and at the bottom of the shaft. The cited spectral curves show that the amplitudes of the oscillations of transverse seismic waves at the surface of the shaft are greater than at a depth of 24 m. The lesser the periods of the seismic oscillations, the greater is the ratio. The amplitude curves constructed for a depth of 24 m have a less expressed maximum, whereas for the surface, on the other hand, the maximum is more clearly expressed.  
[125]

#### BOTTOM GEOTHERMAL SURVEY IN CASPIAN SEA

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 4, 1977 pp 50-54

[Article by V. I. Artemenko and Ya. P. Malovitskiy, Southern Division Institute of Oceanology, "Results of a Bottom Geothermal Survey in the Bakhar Petroleum and Gas Deposit"]

[Abstract] The article describes a polygon survey over the Bakhar petroleum and gas deposit in the southwestern part of the Caspian Sea. The bottom relief is relatively even and the sea depth is 15-17 m. Over almost

the entire area the bottom sediments are represented by finely disperse gray silt. The Bakhar deposit is associated with an anticlinal fold. Profiles were run and geothermal curves were constructed, as well as a geothermal map. It was found that in the investigated area in the bottom layer of sediments at a depth of 1.2 m the temperature varies from 17.1 to 18.3°C, that is, the total amplitude of the variations is 1 or 2°C. A regional decrease in temperatures occurs from the north-northwest to the south-southeast, which corresponds to a monoclinial plunging and an increase in the thickness of the clayey cover of Upper Pliocene-Quaternary age. Against this background one can clearly discriminate a thermoanomalous sector associated with the buried Bakhar deposit which corresponds to a complex maximum of intensity of the order of 0.5°C. The reported data on the bottom geothermal survey in the Bakhar deposit gave encouraging results. These investigations must be continued in other areas for the purpose of accumulating information on possible anomaly-forming factors, especially those associated with deposits of hydrocarbons.

[145]

#### PALEOMESOZOIC AND MESOZOIC RECONSTRUCTIONS OF CONTINENTS AND OCEANS

Moscow GEOTEKTONIKA in Russian No 3, 1977 pp 3-24

[Article by L. P. Zonenshayn and A. M. Gorodnitskiy, Institute of Oceanology, "Paleomesozoic and Mesozoic Reconstructions of Continents and Oceans. Article 2. Late Paleozoic and Mesozoic Reconstructions"]

[Abstract] In an earlier article (see GEOTEKTONIKA, No 2, 1977) the authors discussed a method for preparing palinspastic reconstructions of the former location of the continents and oceans on the basis of geological, paleomagnetic and paleoclimatic data and gave a description of such reconstructions for the Early and Middle Paleozoic. This article continues the examination of the reconstructions in chronological order. The article is organized as follows [each section is accompanied by full-page maps]: Early-Middle Carboniferous, Late Carboniferous-Early Permian, Middle-Late Triassic, Late Jurassic, Late Cretaceous. These time intervals correspond to the joining together of all the continents into the unified continent Pangaea and the subsequent breakup of this megacontinent.

[137]

#### MAPS OF MAXIMUM POSSIBLE EARTHQUAKES IN ARMENIAN HIGHLAND

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR, NAUKI O ZEMLE in Russian No 2, 1977 pp 51-58

[Article by N. K. Karapetyan and Zh. O. Manukyan, Institute of Geophysics and Engineering Seismology Armenian Academy of Sciences, "Maps of Maximum Possible Earthquakes in the Armenian Highland on the Basis of Seismological Data"]



[Abstract] The maximum earthquake possible in Armenia according to graphs constructed on the basis of observational data for a period of 290 years from 1679 to 1968 is  $K = 16$ . However, this intensity is common for the entire region situated between  $\lambda = 40-49^\circ$  and  $\varphi = 38-42^\circ$  (except the Kura depression). In order to have some idea concerning the maximum earthquake possible at each point in the investigated territory it is necessary to construct maps of the maximum possible earthquakes with isolines giving the maximum energy classes of the earthquakes. The authors constructed maps of the maximum possible earthquakes on the basis of seismological data using the Yu. V. Riznichenko method. This method was employed in ascertaining the correlation between the energy class of the maximum possible earthquake and the mean long-term seismic activity. This dependence was used in determining mean long-term seismicity corresponding to each energy class and the level of this activity was used in determining the number of epicenters in an area on a circular grid. The area of this circular grid corresponds to the region of the preparation of an earthquake. Using data on 22 strong earthquakes transpiring in the investigated area, the authors determined the correlation between  $\lg \bar{A}$  and  $K_{\max}$  and obtained a regression equation for the territory of Armenia in the form:

$$\lg \bar{A} = 2.75 + 0.14 (K_{\max} - 15).$$

Several variants of a  $K_{\max}(A)$  map (Figures 1-4) were constructed and are analyzed.

[162]

#### CRUSTAL STRUCTURE IN SOUTHERN PART OF SEA OF OKHOTSK

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 234, No 6, 1977 pp 1421-1424

[Article by V. Yu. Kosygin, Institute of Tectonics and Geophysics, Far Eastern Scientific Center, "Some Characteristics of the Structure and Development of the Earth's Crust in the Southern Part of the Sea of Okhotsk in the Light of Interpretation of Local Gravity Anomalies"]

[Abstract] A map of the anomalous gravity field in the Bouguer reduction was constructed for the water areas of the southern part of the Sea of Okhotsk on the basis of the latest gravimetric data. The averaging method was used in discriminating the local component of the anomalous field (Fig. 1 in the text). It is assumed that with the selected averaging radius (60 km) the local field component is discriminated in the "purest" form. Within the limits of this region on the basis of the structure of the field of local anomalies it is possible to discriminate four anomalous regions: I -- "Peri-Sakhalin"; II -- "Rises of the USSR Academy of Sciences" and contiguous areas; III -- "Basin"; IV -- "Kurile" (these are mapped in Fig. 2). Each region coincides with a corresponding block in the earth's crust defined on the basis of deep seismic sounding data. The crustal blocks, like

the anomalous regions corresponding to them differ from one another with respect to internal structure and also with respect to the thickness of the earth's crust within their limits. The characteristics of each of these anomalous regions are discussed. The geological history of the region is interpreted on the basis of these gravity anomalies.  
[142]

#### CHANGING MODELS OF THE EARTH'S UPPER MANTLE

Moscow PRIRODA in Russian No 5, 1977 pp 22-29

[Article by Ye. N. Milyutina, "Changing Models of the Earth's Upper Mantle"]

[Abstract] This is a review of changing models of the earth's upper mantle, a summarization of how researchers have advanced different hypotheses on the nature of the mantle, a history of how these ideas have been modified as additional information has been accumulated. The author feels that further development of our knowledge of the mantle should be as follows. There is a need for detailed work in tectonically different structures, formulation of definite horizontal inhomogeneous models of the mantle, and broadening of the complex approach -- quantitative interpretation of the totality of available data, taking into account the integrated nature of the crust-mantle system. There must be a systemic approach to seismology itself for the purpose of optimizing methods and forms of research, restructuring of research and formulation of a new logic for the processing of data. As a result of these tendencies, extensive and detailed information will undoubtedly be collected concerning structure of the upper mantle in different regions of the earth. In combination with data from gravimetry, magnetometry and electric prospecting and information on the heat flow this will make it possible to formulate its physical model. Geological investigations, such as study of magmatic and metamorphic rocks on the ocean floor, ophiolite series and the corresponding rocks in them or volcanic inclusions, and also studies of geotectonics will fill out the skeleton, that is, give a good idea concerning the mineralogical composition of the mantle, the phase state of its matter and the processes transpiring in it.

[116]

#### DETERMINING STRUCTURE OF FOCAL RADIATION OF STRONG EARTHQUAKE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 234, No 4, 1977 pp 794-797

[Article by Yu. F. Kopnichev, Institute of Physics of the Earth, "Method for Determining the Structure of Focal Radiation of a Strong Earthquake from the Shape of the Envelope of a P-Wave"]

[Abstract] The author describes in detail a method for determining the structure of focal radiation of a strong earthquake at teleseismic distances on the basis of the shape of the envelope of a P-wave with scattering taken into account. The use of the envelope for this purpose is illustrated on the basis of both experimental and theoretical data and for both strong and weak earthquakes. The analysis revealed a complex structure of the focal radiation. A study of the peculiarities of individual impulses forming the common signal makes it possible by the proposed method to synthesize a model of strong motion in which the principal role is played by S-waves.

[104]

#### PRINCIPAL TYPES OF MAJOR STRUCTURES OF LITHOSPHERIC PLATES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 234, No 5, 1977 pp 1175-1178

[Article by Academician A. L. Yanshin, Ye. V. Artyushkov and A. Ye. Shlezinger, Geological Institute and Institute of Physics of the Earth, "Principal Types of Major Structures of Lithospheric Plates and Possible Mechanisms of Their Formation"]

[Abstract] Horizontal movements of lithospheric plates have been demonstrated by paleomagnetic, lithological, paleontological and other data. However, within the limits of the plates themselves there are undoubtedly quite complex vertical movements with a great amplitude. As a result of these movements different types of major structures have developed which differ with respect to tectonic regime and the nature of sedimentation. Continental platforms are the best studied of these and occupy large areas on the land and shelf. Typical examples of these are the East European, Siberian, North American ancient platforms and the Central Eurasian recent platform. The second major structural element of lithospheric plates is depressions which are associated with the areas of internal and marginal seas. Extensive areas of lithospheric plates are occupied by areas of deuterorogenesis, represented by areas of modern mountain systems. Each of these types is discussed, followed by a detailed description of the demonstrated and hypothetical mechanisms of their development.

[118]

#### TECTONIC PERIODIZATION OF EARTH'S HISTORY

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 234, No 2, 1977 pp 413-416

[Article by Corresponding Member USSR Academy of Sciences A. S. Monin and O. G. Sorokhtin, Institute of Oceanology, "Tectonic Periodization of the Earth's History"]

[Abstract] The geological history of the earth is naturally divided into epochs of increased and reduced intensity of tectonic-magmatic processes measured by the quantity of igneous and metamorphic rocks of corresponding ages in the earth's continental crust. A histogram of the ages of such rocks constructed by R. Dearnley (PHYS. CHEM. EARTH, Vol 7, 1, 1966) shows four maxima with ages of 2.6, 1.9, 1.0 and 0.4-0.25 billion years. The tectonic-magmatic processes observed at the earth's surface are undoubtedly a reflection of deep processes. According to the modern theory of the tectonics of lithospheric plates, the basis for deep processes is convection in the earth's mantle, hypothetically density convection permeating the entire mantle and created by gravitational differentiation of heavy (iron) and light (silicates) substances at the lower boundary of the mantle where it is in contact with the molten outer layer of the core. It is known from hydrodynamics that slow laminar convective movements are organized horizontally into "cells." It is natural to assume that the alternation of tectonic-magmatic epochs, manifested at the earth's surface, can be created by a restructuring of the forms of convective "cells" in the earth's mantle. The least intensive is single-cell convection, in which in the mantle there is one pole of ascent of matter and one (opposite) pole of subsidence. The next in intensity is two-cell convection with so-called closed cells. These two types are discussed in detail, as is a transition from the single-cell to two-cell forms. Specific examples are considered. The article presents a model which includes 9 changes in the forms of convection in the earth's mantle dividing its tectonic history into 10 epochs.

[73]

#### INFLUENCE OF HIGH-RESISTANCE BASEMENT ON MAGNETOVARIATION SOUNDING CURVES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 5, 1977 pp 76-85

[Article by V. P. Bubnov, A. S. Safonov and G. G. Obukhov, All-Union Scientific Research Institute of Geophysical Prospecting Methods, "Influence of High-Resistance Basement on Magnetovariation Sounding Curves"]

[Abstract] A study was made of the patterns observed in magnetovariation soundings in a three-dimensional inhomogeneous medium. The authors also investigated the patterns of change in the shape of magnetovariation curves and the spatial distribution of anomalies in the vertical magnetic field. It was possible to establish a correlation between the characteristic parameters of the magnetovariation sounding curve and the parameters of the model. An example of the practical interpretation of magnetovariation sounding data is given. It was found, for example, that in two-layer three-dimensionally inhomogeneous sections with alternating depressions and rises along the high-resistance basement it is possible to obtain magnetovariation sounding (MVS) curves with peaks and descending branches. Accordingly,

the presence of peaks and descending branches of MVS amplitude curves is not an indisputable indication of the existence of a conducting layer in the section covered by a thick high-resistance screen. For solving this problem in the analysis of data from deep magnetotelluric sounding it is necessary to carry out a spatial analysis of MVS data. It was found that in linearly elongated three-dimensional sections containing periodically repeating depressions and rises of the insulating basement the anomalies excited by the current flowing across the structures can be greater than the anomalies excited by the current flowing along the structures. In an analysis of practical MVS data obtained in such sections it may not be legitimate to use MVS patterns established in two- and three-dimensional models of the section.

[165]

#### STUDY OF CRUMPLING OF BOREHOLE CASINGS IN TECTONIC ZONES

Moscow GEOTEKTONIKA in Russian No 3, 1977 pp 86-90

[Article by N. N. Boltyshev, Northern Caucasus Scientific Research and Production Petroleum Institute, "On One Poorly Studied Peculiarity of Zones of Local Tectonic Dislocations"]

[Abstract] The author examines the probable geological reasons why sites of crumpling of the casings of boreholes are associated with zones of tectonic dislocations. The role of mobility of such zones, the dissimilar degree of tectonic stress of different structural blocks and a number of other factors is considered. Such cases are indicated for a number of petroleum- and gas-bearing regions. For future investigations it is suggested that field polygons be created and that specially equipped observation boreholes be used. Such test boreholes should be selected and adapted from those which have already served their original purpose. This problem is becoming increasingly urgent due to the increase in the volume of drilling work, the increase in depth and cost of borehole drilling.

[137]

#### DIVERSITY OF TYPES OF IGNEOUS ROCKS ON EARTH-GROUP PLANETS

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR, NAUKI O ZEMLE in Russian No 1, 1977 pp 7-14

[Article by V. I. Shmuratko, Odessa State University, "Diversity of Types of Igneous Rocks on Earth-Group Planets"]

[Abstract] The different sea-land relationship on the earth, on the one hand, and on the moon and Mars, on the other, reflects a qualitatively higher degree of differentiation of matter on the earth, in contrast to the moon and

Mars. Anorthosites, high-alumina basalts and other rocks of the continental lunar crust are undoubtedly products of the primary differentiation of protoplanetary matter. In the first stage of lunar development a uniform crust of the continental type developed which was later impaired by outpourings of mare basalts. With this the differentiation of matter in the lunar crust was virtually completed. On the moon the relatively more acidic differentiate evidently plays the role of a substrate in the structure of the crust in which lenses of mare basalt "float." Approximately the same structural position in the general scheme of crustal structure on the earth is played by the granite-gneiss complex of continental blocks "floating" on a basaltic oceanic substrate. The granite-metamorphic "lenses" of the earth's crust, having a lesser density than the rocks of the basalt layer, are positive megaforms of the earth's relief, rising an average of 4.9 km above the level of the ocean floor. The lunar maria, consisting of rocks which are denser than the rocks surrounding them, are on the contrary negative megastructures of lunar relief which are submerged in the continental substrate. With respect to historical geology, the lunar maria occupy a position similar to the terrestrial continents. Much like the granite layer of the earth's continental crust, they lie stratigraphically above the predominating "lunarite" type of crust. The earth, a geologically better-developed planet, with respect to the nature of the predominating type of crust is an oceanic planet. The moon, at a lower level of geological evolution, is a continental planet. The megastructures of the Martian crust, with respect to type and mineralogical composition, are closer to those of the moon. It can scarcely be expected that granites occur widely on Mars.

[113]

#### BEHAVIOR OF SEISMIC WAVES IN PARTIALLY MELTED MEDIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 5, 1977 pp 86-88

[Article by A. O. Gliko and V. N. Zharkov, Institute of Physics of the Earth, "Absorption of Seismic Waves in a Partially Melted Medium"]

[Abstract] In connection with the hypothesis of partial melting of the asthenosphere, it was of interest to find the effective and dissipative parameters of biphase media in which one phase is a melt with the mechanical properties of a viscous Newtonian fluid. In a study by J. B. Walsh (JGR, 74, No 17, 1969) an attempt was made to evaluate the effective quality of the medium consisting of an elastic matrix and ellipsoidal inclusions of a viscous fluid. In actuality, it has been found that the Walsh formula is correct for effective quality with some limitations not noted in his study. In addition to an analysis of these limitations, this communication examines the question as to whether the Walsh formula can explain the absorption of seismic waves in a layer of reduced velocities. It is concluded that if the

nature of the low-velocity layer is associated with partial melting, until now no one has demonstrated that partial melting can give a  $Q$  virtually not dependent on frequency.

[165]

#### CORRECTIONS FOR DYNAMIC SHEAR MODULUS FOR LOVE NUMBERS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 5, 1977 pp 17-21

[Article by V. N. Zharkov and S. M. Molodenskiy, Institute of Physics of the Earth, "Corrections for the Dynamic Shear Modulus for Love Numbers"]

[Abstract] In earlier studies (S. Ts. Akopyan, DOKL. AN SSSR, 223, No 1, 1975; IZV. AN SSSR, FIZIKA ZEMLI, No 10, 1976) it was pointed out that models of an inelastic earth are essentially dependent on frequency. Due to dissipation, the distribution of the mechanical quality  $Q_\mu(l)$  in the earth's deep layers, the dynamic shear modulus for the deep layers will be different for body waves (periods  $\sim 1$  sec), characteristic oscillations (periods 1-54 min) and for tides (periods  $\sim 1-10^2$  days). A correction for the dynamic shear modulus for characteristic periods was examined before; the purpose of this communication is the introduction of this correction into Love numbers for earth tides. Introduction of this correction into Love numbers is of special interest because it expands by two orders of magnitude the range of periods in which mechanical quality  $Q_\mu(l)$  is probed. The article can be regarded only as a first step in this direction. The magnitude of the correction is about 1%, which in some cases exceeds the observation errors. The authors indicate the possibility of using these corrections for studying the dissipative properties of the earth's deep layers in the case of superlong periods.

[165]

#### DISLOCATIONS AT EARTHQUAKE FOCI BEFORE AND AFTER EARTHQUAKES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 5, 1977 pp 38-46

[Article by O. G. Shamina and R. V. Khanutina, Institute of Physics of the Earth, "Nature of Dislocations at the Foci of Weak Tremors Before and After a Strong Earthquake"]

[Abstract] An analysis of the behavior of the dislocation and displacement plane at the foci of weak tremors preceding and accompanying a strong earthquake is made on the basis of the theory of the mechanics of destruction. The observed behavior is compared with the results of tectonophysical investigations. The method for determining the dislocation planes at the foci

of Garm earthquakes is discussed in detail, as are the results of determination of the dislocation plane during foreshocks and aftershocks. Comparisons show a common nature of the destruction processes transpiring in the field of tectonic stresses at the scale of a region and at the scale of an individual earthquake focus during the time of preparation for and occurrence of a strong tremor. The results experimentally confirm the possibility of application to an earthquake focus the theoretical premises of the mechanics of destruction on the preparation for and development of a major disruption of continuity. The results can serve as a basis for using the orientation of the dislocation planes in weak earthquakes as precursors of the occurrence of a stronger earthquake.

[165]



## V. UPPER ATMOSPHERE AND SPACE RESEARCH

### News

#### TASS ANNOUNCES LAUNCHING OF "KOSMOS-931"

Moscow PRAVDA in Russian 21 Jul 77 p 2

[TASS Report: "'Kosmos-931'"]

[Abstract] The artificial earth satellite "Kosmos-931" was launched in the Soviet Union on 20 July 1977. The satellite was inserted into an orbit with the following parameters:

- initial period, 12 hours 06 minutes;
- apogee, 40,180 kilometers;
- perigee, 600 kilometers;
- orbital inclination, 62.8 degrees. [5]

#### TASS ANNOUNCES LAUNCHING OF "KOSMOS-932"

Moscow PRAVDA in Russian 21 Jul 77 p 2

[TASS Report: "'Kosmos-932'"]

[Abstract] The artificial earth satellite "Kosmos-932" was launched in the Soviet Union on 20 July 1977. The satellite was inserted into an orbit with the following parameters:

- initial period, 89.5 minutes;
- apogee, 342 kilometers;
- perigee, 180 kilometers;
- orbital inclination, 65 degrees. [5]

#### TASS ANNOUNCES LAUNCHING OF "KOSMOS-933"

Moscow IZVESTIYA in Russian 24 Jul 77 p 2

[TASS Report: "'Kosmos-933'"]

[Abstract] The artificial earth satellite "Kosmos-933" was launched in the Soviet Union on 22 July 1977. The satellite was inserted into an orbit with the following parameters:

- initial period, 92.5 minutes;
- apogee, 418 kilometers;
- perigee, 385 kilometers;
- orbital inclination, 65.8 degrees. [5]

#### ALL-UNION CONFERENCE ON ATMOSPHERIC OPTICS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 13, No 5, 1977 pp 561-563

[Article by V. Ye. Zuyev and V. P. Lukin, "All-Union Conference on Atmospheric Optics (25-27 June 1976, Tomsk)"]

[Abstract] The First All-Union Conference on Atmospheric Optics (Chairman of Organizing Committee Corresponding Member USSR Academy of Sciences V. Ye. Zuyev), organized by the Institute of Atmospheric Optics Siberian Department USSR Academy of Sciences, was held in Tomsk during the period 25-27 June 1976. The conference was attended by 256 persons from 25 cities in the Soviet Union, representing 70 scientific research institutes and governmental agencies. Five sections operated at the conference. In Section I, "Absorption of Optical Waves in the Atmosphere," two directions were stressed: attenuation of radiation in the transparency windows and investigation of the atmospheric content of small impurities. Section II dealt with study of the scattering and propagation of optical waves in randomly inhomogeneous media. In this section the first session was devoted to the propagation of optical waves in the turbulent atmosphere, the second session dealt with investigation of aerosol in the surface layer of the atmosphere, the third session concerned the propagation of radiation in scattering media, and the theme of the fourth session was a study of the characteristics of the upper atmosphere. In Section III, "Inverse Problems in Atmospheric Optics," the subjects discussed were determination of the refractive index and microstructure of atmospheric aerosol on the basis of data from optical measurements. Section IV was devoted to nonlinear effects in the propagation of optical radiation in the atmosphere. This report, in a sentence or two, gives some information on the different reports. It was decided that such conferences should be held each three years.

[106]

INTERVIEW WITH CANDIDATE OF TECHNICAL SCIENCES V. NESTEROV

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 18 Jun 77 p 4

[Interview by G. Lomanov, "June 'Snow'"]

[Summary] The "Sneg-3" is the third satellite which is specialized for investigation of cosmic gamma radiation. [The first was launched by the United States, the second by a group of four European countries.] In addition to gamma radiation, the "Sneg-3" will study nonstationary sources. On the proposal of Soviet physicists, the scientific instrumentation has been supplemented by special automatic devices making it possible to register gamma bursts and bursts of hard X-radiation and make a detailed investigation of their characteristics. This additional instrumentation will make it possible to employ the French satellite in a complex program for the investigation of this phenomenon and by use of the triangulation method to determine the coordinates of the bursts with a good accuracy. It is becoming possible to tie-in the bursts to definite celestial bodies and each such identification is usually accompanied by interesting discoveries. The satellite itself is a short cylinder oriented with one axis on the sun. The principal instrument registering gamma radiation looks in the opposite direction and is inclined to the axis approximately ten degrees. Since the satellite rotates, the telescope axis cuts a cone in the sky with an aperture angle of  $20^\circ$ . During the year the sun describes a complete circle in the sky and the "Sneg-3" pointed at it during this period by means of the gamma telescope scans a quite broad zone along the ecliptic. As the "Sneg-3" studies the expanses of the universe, at a number of observatories in the USSR astronomers will direct ordinary telescopes at these same sectors of the sky. And it is not impossible that it will be possible to identify the source of the burst registered on the satellite with some celestial body simultaneously flaring in the optical wavelength range.

[111]

NOTES ON PHOTOGRAPHIC OBSERVATIONS FROM SPACE

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 5, 1977 pp 36-37

[Article by Engineer N. Tolkachev, "Cameras in Orbit"]

[Abstract] Since the pointing of cameras at surveyed features is accomplished by the orientation of a ship or station, prior to launching there is a photometric and photogrammetric calibration of the cameras to be carried aboard for the purpose of determining the accurate position of their coordinate axes relative to the axes of the ship or station. Frequently in order to tie in the photos to the terrain it is adequate to note the time of the survey on them. But in some cases, especially when the survey is made in the interests of geology, geodesy and cartography, simultaneously with

photographing of terrain sectors there is a synchronous survey of the stars, which makes possible an increase in the accuracy of the tie-in. The photographing of stars is accomplished using special automatic devices at rigorously stipulated time intervals... It has been established that the greatest volume of information on natural features and the environment is obtained using photographs taken with a solar altitude not less than 20°. Comparison of photos of the very same terrain, taken in different seasons of the year, makes it possible to extract additional information on the transpiring seasonal changes. In the territory of the Soviet Union there are several polygons -- regions differing with respect to natural and climatic conditions and being of maximum interest from the point of view of study of the environment. In such polygons specialists have repeatedly carried out subsatellite experiments in which the observations of space-ships and orbital stations are supplemented by specially equipped aircraft and ground teams. In some cases a space survey is preceded by an aerial survey of the planned regions at different scales and as a result initial data are obtained for the space survey, such as required resolution on the ground, optimum solar altitude, overlapping of photographs, regimes of spacecraft orientation. Cosmonauts can photograph not only features in accordance with the instructions of the ground control group, but also independently, in the course of visual observations. The photochemical processing of the film and interpretation are carried out on the ground after return of the crew. On the basis of the records of cosmonauts in their journals, synoptic charts and TV photographs obtained from meteorological satellites and other materials specialists carefully analyze the conditions of the survey -- the actual state of the weather, atmospheric transparency, characteristics of the photographed route and illumination; they compute the exposures obtained on the photographic film in each specific case. These data are used in formulating the developer and the development regimes in order to obtain the maximum information on the film.

[143]

## Abstracts of Scientific Articles

### GLOBAL PHYSICAL PROCESSES AND THE ENVIRONMENT

East Berlin ZEITSCHRIFT FUER METEOROLOGIE in German Vol 27, No 1, 1977 pp 1-20

[Article by K. Bernhardt, Humboldt University, Physics Section, Meteorology and Geophysics Area, East Berlin, and E. A. Lauter, Institute for Solar and Terrestrial Physics, Academy of Sciences GDR]

[Abstract] Global scale physical processes affecting the development of the biosphere and noosphere are discussed in the authors' paper based on a lecture delivered at the KAPG symposium on "Natural and Anthropogenic Changes in the Physical Environment" held in Leipzig in April 1976. The global physical processes in the planetary environment reflect general physical laws under the specific conditions typical for the earth as a planet. These processes in the various geospheres exhibit considerable complexity and constantly interact with one another among the geospheres. The nonlinearity of the processes additionally causes an intensive interaction among the various spatial and temporal scales. The spatial scales may range from small turbulence to planetary scale processes and the temporal scales may range from  $10^{-3}$  seconds to  $10^{16}$  seconds. These interactions among processes of various scales manifest themselves in a pronounced hierarchical nature of the physical processes of the planetary environment with highly coupled parts and subsystems so that regional processes, for example, may become part and a result of the global processes; a decisive factor for the maintenance of the planetary atmospheric processes is the influx of solar energy. This energy is transformed in various layers of the atmosphere. The earth's magnetic field provides a shield against various factors. The various processes affect the climate and weather conditions and knowledge about the processes and the physical relationships permits the forecasting of weather and other planetary phenomena. It is important to establish a list of research priorities. Multidimensional statistical techniques must be used. Both state and process parameters must be established. Only international cooperation can yield useful results. There is danger that the results of such studies can be used for military purposes, for example, by developing methods for climatic changes.

[157]

## DIURNAL VARIATIONS OF LEAKING CORPUSCULAR RADIATIONS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 3, 1977 pp 491-495

[Article by V. F. Tulinov, V. M. Feygin, M. A. Savel'yev, Yu. M. Zhuchenko, V. A. Lipovetskiy, V. A. L'yachenko, A. P. Babayev, T. A. Zhuchenko, V. V. Tulyakov and L. S. Novikov, Scientific Research Center for the Study of Natural Resources, Main Administration of the Hydrometeorological Service, "Experimental Study of Diurnal Variations in Leaking Corpuscular Radiations"]

[Abstract] This paper gives some results of measurements of the electron component of corpuscular radiations and presents an analysis of the diurnal variations of fluxes of leaking electrons. A middle-latitude experiment was carried out in the autumn of 1974 in two stages, during which about 20 meteorological rockets were launched (ascent to 160-180 km). The rocket launchings were carried out under different geophysical conditions: during a quiet period and during periods of polar magnetic substorms, during different periods of the day, and accordingly, with different positions of Kheys Island relative to the auroral oval. The results are presented. For example, during the period of the experiment variations of the energy fluxes transported by electrons with  $E_e = 1-100$  keV did not exceed  $5 \cdot 10^{-3} - 4 \cdot 10^{-2}$  erg/cm<sup>2</sup>sec. A comparison of the results with the results of the complex experiment "Sun-Atmosphere 1971" reveals a quite constant and high level of the intensity of the electron fluxes acting on the middle-latitude atmosphere during the period of the experiment of 1974 (September-October). Still another peculiarity of the registered electron fluxes is the shape of their energy spectra -- a very sharp increase in intensity in the region of energies less than several tens of keV with a maximum in the region 10-15 keV. Such spectra are characteristic for electron fluxes acting on the middle latitude atmosphere during periods of geomagnetic disturbances.

[159]

## TRAIL OF BODY MOVING RAPIDLY IN MAGNETIZED PLASMA

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 3, 1977 pp 410-417

[Article by A. P. Dubovoy and A. A. Yaroslavtsev, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Trail of a Body Moving Rapidly in Magnetized Plasma"]

[Abstract] The problem of perturbations induced in rarefied magnetized plasma by a rapidly moving (in comparison with the mean thermal velocity of ions) body is of interest on a purely theoretical basis and from the point of view of explaining some experiments in laboratory and space plasma. In this paper the formulas derived by L. P. Pitayevskiy (GEOMAGN. I AERONOMIYA, 1, 194, 1961) are simplified in Fourier space for cases of small (near

zone) and great (distant zone) distances in comparison with the Larmor radius of ions. For small distances it was possible to compute corrections to the values describing the perturbation in unmagnetized plasma. At great distances in the stipulated plane it was possible to derive asymptotic formulas in the form of integrals which were computed numerically.  
[159]

#### EFFECT OF IONOSPHERIC DISTURBANCES ON POLARIZATION FADING FREQUENCY

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 3, 1977 pp 450-454

[Article by Yu. K. Postoyev and B. V. Troitskiy, Khar'kov State University, "Effect of Ionospheric Wave Disturbances on Frequency of Polarization Fading During Radio Communication with an Artificial Earth Satellite"]

[Abstract] A study was made of the time dependence of the frequency of polarization beats of a signal from the Explorer 27 artificial earth satellite at a frequency of 20 MHz, whose spectral processing gave two clearly expressed peaks at frequencies corresponding to periods of about 22 and about 13 sec, evidence of presence of intermediate-scale moving disturbances in the ionosphere with horizontal wavelengths of about 150 and about 90 km. A study was made to determine how these figures correspond to reality, to ascertain what response of ionospheric disturbances there is to radio waves propagating from a passing satellite and how this response is dependent on the parameters of the orbit and medium. An effort was made to ascertain the accuracy of the formulas used in processing the experimental data. Ray modeling is used in clarifying these problems.  
[159]

#### REVIEW OF STUDY OF NATURAL RESOURCES BY REMOTE SENSING

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 4, 1977 pp 1-9

[Article by G. T. Beregovoy and Yu. P. Kiyenko, "Study of the Earth's Natural Resources by Remote Sensing Methods"]

[Abstract] The authors review the different aspects of use of remote sensing from space for study of the earth's natural resources and define the probable course of development of this line of work. It is clear that the traditional points of view developed in the experience of use of aircraft must be considerably overhauled. Without question, for study of natural resources multipurpose and specialized artificial earth satellites will be used, together with automatic spacecraft, manned and visited orbital stations. These spacecraft, in rational combinations, will carry different remote sensing devices. An important problem in the use of space information

on natural resources is not only the process of collecting the data, but also the process of their interpretation. In several minutes a spacecraft can record a volume of information which can be obtained in an aircraft in a year. Naturally, traditional methods cannot be employed in processing satellite data. There must be a highly automated system for the processing of information based on super-high-speed electronic computers. The space information is usually multipurpose, necessary for many branches of the national economy, and therefore its primary processing and preparation for specialized, departmental use, must be accomplished on a centralized basis. The branch use of space information for investigations of the earth's resources even today is giving practical results. There have been important achievements in the field of study of deep layers, forest and water resources, engineering investigations, and mapping of areas. In particular, using materials from a space survey of the Caspian Sea, carried out in different parts of the visible and near-IR spectral regions, it was found to be possible to study the relief of shallow-water areas, underwater vegetation, bottom deposits and the coastal shelf. On the basis of TV photographs of the West Siberian Lowland, obtained using the "Meteor" artificial satellite, it was possible to discover large deep faults hidden under the kilometer-thick thickness of unconsolidated recent formations and this made possible a considerable revision of ideas concerning the distribution of petroleum and gas deposits of this major region. The interpretation of photos of the ore-bearing Altay obtained from manned spaceships made it possible to evaluate the prospects for detecting valuable minerals in this region. Space surveys are making it possible to put observations of the dynamics of natural processes on a new scientific and technical level. These and other uses of space photos will yield savings of hundreds of millions of rubles.

[131]

#### MODEL OF LUNAR GRAVITATIONAL FIELD

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 235, No 1, 1977 pp 38-41

[Article by E. L. Akim and Z. P. Vlasova, Institute of Applied Mathematics, "Model of the Lunar Gravitational Field According to Observations of the Motion of its Artificial Satellites 'Luna-10, 12, 14, 19 and 22'"]

[Abstract] A study was made of the global structure of the lunar gravity field on the basis of observations of the motion of the "Luna-10, 12, 14, 19 and 22" in this field for prolonged intervals. For describing the selenocentric motion of the satellite and the motion of the moon about its center of mass the authors used a Cartesian rectangular selenocentric coordinate system XYZ. The plane XY in this system coincides with the plane of the mean lunar equator and the plane XZ coincides with the plane of its zero meridian for a fixed epoch  $t_0$ . The directions of the axes of the



coordinate system are fixed relative to the stars; the X axis is directed at the time  $t_0$  toward the earth, the Z axis -- toward the lunar north pole, the Y axis supplements the system to the right. The motion of the satellite is presented in elements of its orbit: semimajor axis  $a$ , eccentricity  $e$ , inclination  $i$ , longitude of the ascending node  $\Omega$ , angular distance of the pericenter from the node  $\omega$  and time of transit of the ascending node  $T_\Omega$ . The reckoning of the angular orbital elements  $i, \Omega, \omega$  is from the plane of the mean lunar equator and its zero meridian for the epoch  $t_0$ . It is assumed that the lunar rotation about its characteristic center of mass occurs in accordance with the Cassini laws -- uniformly about the fixed axis Z of the introduced coordinate system. The motion of the center of lunar mass in a geoequatorial coordinate system with the mean equinox of the epoch 1960.0 is stipulated by the Brown-Eckert theory. With this formulation of the problem, a model of the lunar gravitational field is presented. [173]

#### USE OF MINIMUM MODULI METHOD IN ADJUSTMENT OF OBSERVATIONS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA in Russian No 2, 1977 pp 21-26

[Article by A. I. Bolotin, Leningrad Civil Engineering Institute, "Properties of Corrections in the Adjustment of Observations by the Least Moduli Method"]

[Abstract] The least moduli method has now found some use in the processing of orbital information (V. I. Mudrov, et al., KOSMICHESKIYE ISSLEDOVANIYA, Vol VI, No 4, 1968). The least moduli method is the most effective method for the processing of observations whose dispersion is known only on the average for the entire set of observations. This article describes the properties of the corrections which must be applied to the results of measurements made by the least moduli method. The presented theory and examples show that adjustment by the least moduli method in some cases creates uncertainty and denies the need for measurements of excess elements. The described properties of the corrections more fully characterize the merits of the method and indicate the possible ways to simplify solution of problems of this type.

[172]

#### USE OF GRADIENT METHOD IN STUDYING SPACEFLIGHT DYNAMICS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 3, 1977 pp 331-335

[Article by V. L. Ponomareva, "Application of the Gradient Method to Solution of Some Problems in the Dynamics of Spaceflight"]

[Abstract] A study was made of use of the gradient method (see T. M. Eneyev, KOSMICH. ISSLED., 4, 651, 1966) in the problem of optimum control in the case of a limited time for execution of a maneuver. As an example, the author solves the problem of ascertaining the maximum angle of rotation of the orbital plane of an artificial earth satellite in the case of a restricted reserve of the characteristic velocity and with a stipulated time for execution of the maneuver. A simple algorithm is proposed for synthesis of optimum control of the maneuver of rotation of the AES orbital plane; this algorithm can be realized aboard the vehicle when it is in an autonomous regime.

[147]

#### CODING OF SIGNALS IN IONOSPHERIC SOUNDING

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR, SERIYA FIZIKO-TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 2, 1977 pp 47-50

[Article by B. G. Barabashov, V. G. Kalyadin and M. Shirmammedov, Rostov-on-Don State University and Physical-Technical Institute Academy of Sciences Turkmen SSR, "Experience in Using Coded Signals in Ionospheric Sounding"]

[Abstract] This article gives a description of apparatus in whose development the objective was to achieve time compression of a wide signal by an analog device, using components produced by industry. The probing signal selected was a signal manipulated in phase in accordance with a seven-position Barker code in the form 1 110 010. The duration of the elementary signal was  $64 \mu\text{sec}$ . Such a choice of signal parameters is not by chance. First, with the indicated duration it is possible to use as the delay element the standard ultrasonic delay line employed in color television sets. Second, the optimum passband in the receiver corresponding to such a signal is 21 kHz and can be obtained easily in the commonly used R-250 receivers. Finally, the total duration of  $448 \mu\text{sec}$  ensures the possibility of obtaining a reflection from the E layer during vertical sounding without overlapping of the reflected and emitted signals. Figure 1 is a functional diagram of the unit used in shaping the coded radio pulse for transmission. The principle and functioning of the system are discussed. The described apparatus ensures a power gain by a factor of about 7 and an improvement in the signal-to-noise ratio by a factor of 2.7.

[125]

#### PROCESSING OF SPACE PHOTOGRAPHS OF SEAS OF USSR

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA in Russian No 2, 1977 pp 64-72

[Article by V. V. Polovinko, Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers, "Some Results of Processing of Near-Vertical Images of the Seas of the USSR Taken from the 'Meteor' Artificial Earth Satellite"]

[Abstract] This paper examines the special problem of study of the meso-structure of the radiation field of the seas of the USSR from near-vertical images obtained using the "Meteor" AES. The equipment of the satellite, in addition to microwave and IR apparatus, included a scanning system making it possible to obtain an image of one and the same sector of the sea surface in four spectral ranges: 0.5-0.6, 0.6-0.7, 0.7-0.8 and 0.8-1.1  $\mu\text{m}$  on photographic film. The images selected for processing were of the Barents, Black and Caspian Seas and the Sea of Azov. On the basis of the optical two-dimensional spectral analysis of near-vertical images of the Black Sea surface it was assumed that the mesostructure of the radiation field of sea surfaces is isotropic. Particular attention was given to the contrast and periods of the mesostructure of sea radiation; it was found that these have a Rayleigh distribution.

[172]

#### MOTION OF BEAM OF CHARGED PARTICLES IN MAGNETOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 3, 1977 pp 482-490

[Article by I. S. Veselovskiy, Nuclear Physics Institute, Moscow State University, "Motion of a Beam of Charged Particles in the Earth's Magnetosphere"]

[Abstract] Computations of the parameters of a beam injected into the magnetosphere under definite conditions can be made in the approximation of test particles moving in stipulated electric and magnetic fields. The trajectories of particles are found by integration of the equations of motion and are used for computing the parameters of the beam in general. The application of such a program requires rather unwieldy numerical computations on an electronic computer. In the near magnetosphere with  $L < 6$  the analysis is considerably simplified because the magnetic field in this region can be considered a dipole with a sufficient degree of accuracy. In this paper the author investigates the peculiarities of motion of the injected beam with very simple distribution functions in the dipole field. Stationary distributions and individual pulses of different duration are considered. The shape of the pulse is computed.

[159]

#### SIDEREAL-DIURNAL COSMIC RAY VARIATIONS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 3, 1977 pp 377-380

[Article by A. I. Gavril'yev, P. A. Krivoshapkin, A. I. Kuz'min, G. V. Skripin and V. A. Filippov, Space Physics and Aeronomy Research Institute Yakutsk Affiliate Siberian Department USSR Academy of Sciences, "Sidereal-Diurnal Variation of Cosmic Rays"]

[Abstract] This paper gives some results of study of the sidereal-diurnal variation on the basis of data from long-term continuous observations of the muon intensity of cosmic rays at Yakutsk. Muon telescopes were placed on the ground surface and beneath the ground at depths of 7, 20 and 60 m water equivalent. The direction of registry was north and south at an angle of  $30^\circ$  to the zenith and vertical. This complex of telescopes makes it possible to investigate primary cosmic rays in the energy range 20-200 GeV. The mass of data was divided into two periods: 1) 1958-1970, 2) 1971-1975. The crossed telescopes method was used for excluding the meteorological effects. The totality of experimental data indicates that after 1968 in cosmic rays with energies  $E \geq 50$  GeV there is an anisotropy with an amplitude of 0.02-0.04% and with a maximum at 0300-0600 hours sidereal time. [159]

#### SEPARATION OF COSMIC RAY VARIATIONS OF DIFFERENT ORIGIN

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 3, 1977 pp 387-393

[Article by L. I. Dorman, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Generalization of the Spectrographic Method and Sounding of Meteorological Conditions Using Cosmic Rays"]

[Abstract] A general solution was obtained for the problem of separation of the variations of cosmic rays of atmospheric, geomagnetic and extraterrestrial origin and also sounding of variations of the vertical temperature profile of the atmosphere and the mass of columns of air over the observation levels using a spectrographic complex of instruments making it possible to register synchronously the different stable and unstable components of cosmic rays. The number of instruments can be substantially less than the total number of equations because each instrument makes it possible to register several components of cosmic rays differing with respect to coupling coefficients, barometric coefficients and the densities of the temperature coefficients. The appropriate coupling coefficients for different components are cited by the author in EKSPERIMENTAL'NYYE I TEORETICHESKIYE OSNOVY ASTROFIZIKI KOSMICHESKIKH LUCHEY, "Nauka," 1975, whereas the barometric coefficients and the temperature density coefficients are given by the author in METEOROLOGICHESKIYE EFFEKTY KOSMICHESKIKH LUCHEY, "Nauka," 1972. [159]

#### DETERMINING ATMOSPHERIC TURBIDITY FROM PYRANOMETRIC MEASUREMENTS

East Berlin ZEITSCHRIFT FUER METEOROLOGIE in German Vol 27, No 1, 1977  
pp 68-71

[Article by Christian Haensel, Physics Section, Geophysics Faculty, Karl Marx University, Leipzig]

[Abstract] Rietz reported in his paper (GERL. BEITR. GEOPH., Vol 55, 1939, pp 253-291) that the relationship between the intensity of the diffuse celestial radiation under cloudless sky and the radiative loss of direct sunlight through its path in the atmosphere varies very little and is constant. This value is essentially unaffected by the position of the sun and the degree of atmospheric turbidity. Using the empirical formula derived by Rietz, the authors determined the turbidity factor from pyranometric measurements. The calculation method described in this article gave results which agreed well with actinometric results. Actinometric measurements are much more complex than pyranometric measurements. Data on atmospheric turbidity for Heiligendamm, Potsdam and Fichtelberg, where radiation-measuring facilities exist, are given in tables. Information is also presented for a ten-year period (1961 to 1970). It was also established that adjustments for solar altitude would make the results even more accurate.  
[157]

#### OPTIMUM PARAMETERS OF SATELLITE WITH TWO STABILIZERS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 3, 1977 pp 352-362

[Article by V. A. Sarychev and N. I. Yakovlev, "Optimum Speed Parameters of Satellite with Two Stabilizers"]

[Abstract] In this article the authors have derived equations of motion for a satellite-stabilizers system. It is assumed that the coupling of each stabilizer to the satellite is accomplished by means of a viscoelastic suspension of the rotational or translational type with one degree of freedom. All the positions of equilibrium of the satellite-stabilizers system were determined. A satellite with two stabilizers is examined in detail. The article gives for it the conditions of stability near the position of equilibrium and determines the parameters optimum with respect to speed.  
[147]

#### COMPENSATION OF ECCENTRIC OSCILLATIONS OF SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 3, 1977 pp 376-383

[Article by V. I. Pen'kov, "Compensation of Eccentric Oscillations of a Satellite with a Gravitational Stabilization System"]

[Abstract] A study was made of small oscillations of a system of two bodies (satellite and stabilizer) connected by means of a viscoelastic suspension in the plane of an almost circular orbit. Analysis of the basic problems of dynamics of such systems is given in earlier studies (J. P. C. Clark, J. SPACECRAFT AND ROCKETS, 7, No 3, 294, 1970, and elsewhere). It is shown that the generalization of the scheme considered in these earlier studies makes it possible to ensure compensation of eccentric oscillations of a satellite with a retention of asymptotic stability of the system.  
[147]

#### PHOTOELECTRONS AND ELECTRONS IN PLASMOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 3, 1977 pp 441-444

[Article by G. V. Khazanov, M. A. Koyen and S. I. Barayshchuk, "Trapped Photoelectrons and Secondary Electrons in the Middle-Latitude Plasmosphere. II"]

[Abstract] In an earlier study by these authors (KOSMICH. ISSLED., 15, No 1, 1977) there was an analysis of the stationary problem of the capture of photoelectrons and secondary electrons by the geomagnetic field. The purpose of this communication is a study of a nonstationary model of the distribution of trapped high-energy electrons in the middle-latitude plasmosphere. In this second part of the investigation the authors give an evaluation of the characteristic times for establishing the spectrum in the capture zone for different energies and there is a comparison of the results of analytical and numerical models describing the capture of photoelectrons and secondary electrons by the geomagnetic field.  
[147]

#### IR SPECTRA OF LUNAR REGOLITH

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 3, 1977 pp 475-478

[Article by M. N. Markov, G. M. Grechko, A. A. Gubarev, Yu. S. Ivanov and V. S. Petrov, "Infrared Spectra of Regolith According to Measurements from the 'Salyut-4' Orbital Station"]

[Abstract] On the "Salyut-4" orbital manned station specialists carried out an experiment for determining the emission spectrum of the moon in the range 1-8  $\mu$ m. This range extends over considerable parts of the spectrum where reflected and characteristic lunar radiation is concentrated. An IR telescope-spectrometer, the ITS-K, was used in the observations. The instrument had a main telescope mirror with a diameter of about 0.3 m and a

focal length of 0.45 m. Its angular resolution was  $8' \times 16'$  ( $1.1 \times 10^{-5}$  sr). The spectrometer had a monochromator with a fluorite prism, with the time used in registry of the spectrum of 2.5 sec. The detector was of germanium, alloyed with gold, cooled to 50°K. The telescope and spectrometer were at a temperature close to normal. At the time of lunar observation this temperature was +18°C. The output signals were registered using a magnetic recorder. The lunar spectra in the range 3.5-7  $\mu$ m obtained as a result of processing of the measurements of 27 January 1975 indicate a reflection maximum up to 70% at a wavelength of 4  $\mu$ m.  
[147]

#### CORRELATION BETWEEN COSMIC RAY VARIATIONS AND SOLAR ACTIVITY

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 3, 1977 pp 479-481

[Article by P. P. Ignat'yev, N. G. Galachev and V. P. Okhlopov, "Correlation Between Cosmic Ray Variations and Solar Activity"]

[Abstract] The curves of intensity of galactic cosmic rays and solar cosmic rays change in antiphase and exhibit a characteristic lag relative to the  $R_z$  curve clearly manifested in the epoch of the minimum of helioactivity (1963-1965). Since this circumstance indirectly indicates the dimensions of the region of modulation of galactic cosmic rays in the solar system, a refinement of the delay time is of unquestionable interest. For this purpose the authors computed the correlation functions between  $R_z$  and the intensity of galactic cosmic rays during 1959-1974 and also between  $R_z$  and the intensity of solar cosmic rays during 1965-1974. The averaging interval was a half-year, which made it possible to smooth the influence of 27-day variations. The results of the computations show a lag for galactic cosmic rays by  $0.50 \pm 0.25$  year with correlation coefficients  $r = -0.91 \pm 0.03$ ; assuming the mean velocity of the solar wind to be about 300 km/sec, one obtains for the radius of the modulation region a value of about 30 a.u. Between  $R_z$  and solar cosmic rays there is a positive correlation  $r = 0.92 \pm 0.25$  corresponding to this same lag. A further analysis shows that during the course of the 19th and 20th solar activity cycles there is both a lag and an outpacing of the amplitude of 27-day variations of galactic cosmic rays relative to the  $R_z$  variations, during some periods attaining an entire year. Some of the possible explanations for this phenomenon are examined. [It is noted that in the journal SOLAR PHYSICS, 42, 497, 1975, there was an article by P. Hedgecock in which it was experimentally shown that during the period 1970-1971 the variations of the heliomagnetic field outpaced the effects in cosmic rays. This result confirms the conclusions presented in this article.]  
[147]

## SPACE RESEARCH FOR STUDYING EARTH'S NATURAL RESOURCES

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, GEOGRAFIYA in Russian No 1, 1977  
pp 37-44

[Article by Yu. F. Knizhnikov and V. I. Kravtsova, Aerial Methods Laboratory, Moscow State University]

[Abstract] There are two principal types of space survey in the optical and near-IR ranges -- photographic and scanner. Surveys from aircraft laboratories have become a component part of investigations of natural resources by space methods. Space photographs are used very extensively in geology. This is because of the high degree of photographic generalization of the image, affording a possibility for studying major dislocations and structures. With respect to study of the ocean, it is now possible to make virtually simultaneous determinations of the temperature field of the water surface over enormous areas, making it possible to approach a solution of very important problems in oceanology. Surveys from meteorological satellites in the visible and IR regions make it possible to determine the position of the ice edge and polynias, to detect zones of ice of different continuity. Geographers have acquired a tool which makes it possible in a relatively short time to compare global information on the earth's surface. Much is expected from the use of space photographs for solution of the problem of revision of topographic maps. The vastness of the data collected from space makes the use of automatic processing systems mandatory. Work with space photos requires the training of specialists with expertise in both technical and geographical research methods. This is a pressing problem. An equally important problem is the use of space information in the teaching of many geographical disciplines -- physical geography, geomorphology, geography of soils and the plant world, oceanology and meteorology.

[191]

## USE OF MULTISPECTRAL PHOTOGRAPHY IN REMOTE PROSPECTING

East Berlin VERMESSUNGSTECHNIK in German Vol 25, No 3, 77 pp 78-81

[Article by Professor H. Kautzleben and V. Kroitzsch, Technology Department Central Institute for Terrestrial Physics]

[Abstract] The MKF 6 multispectral camera, developed by Carl Zeiss State Enterprise in Jena has already been used aboard the "Soyuz-22" and a Soviet experimental aircraft of the AN-30 type for remote prospecting. Together with the MSP-4 multispectral projector it now represents an instrument system for obtaining and evaluating multispectral photographs. The projector was also developed by Carl Zeiss State Enterprise. Remote prospecting with this system provides information on both the geometrical



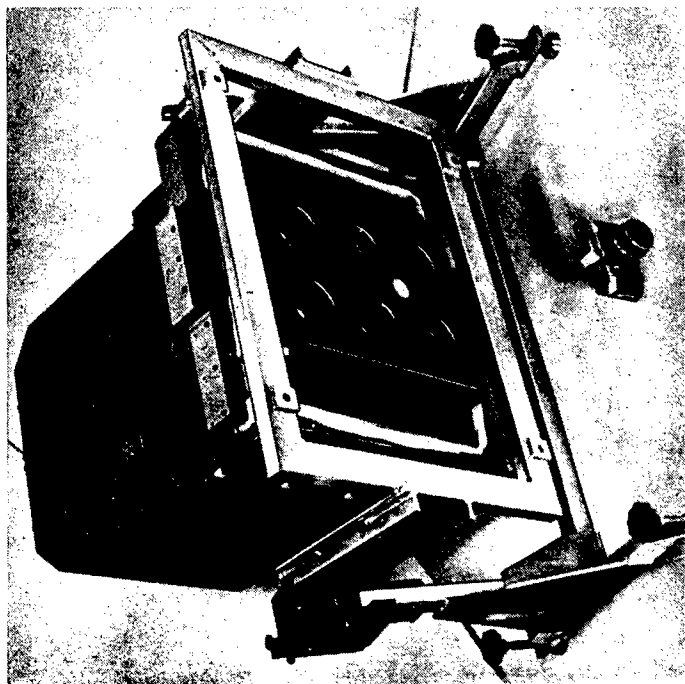


Fig. 1. The MKF multispectral camera.

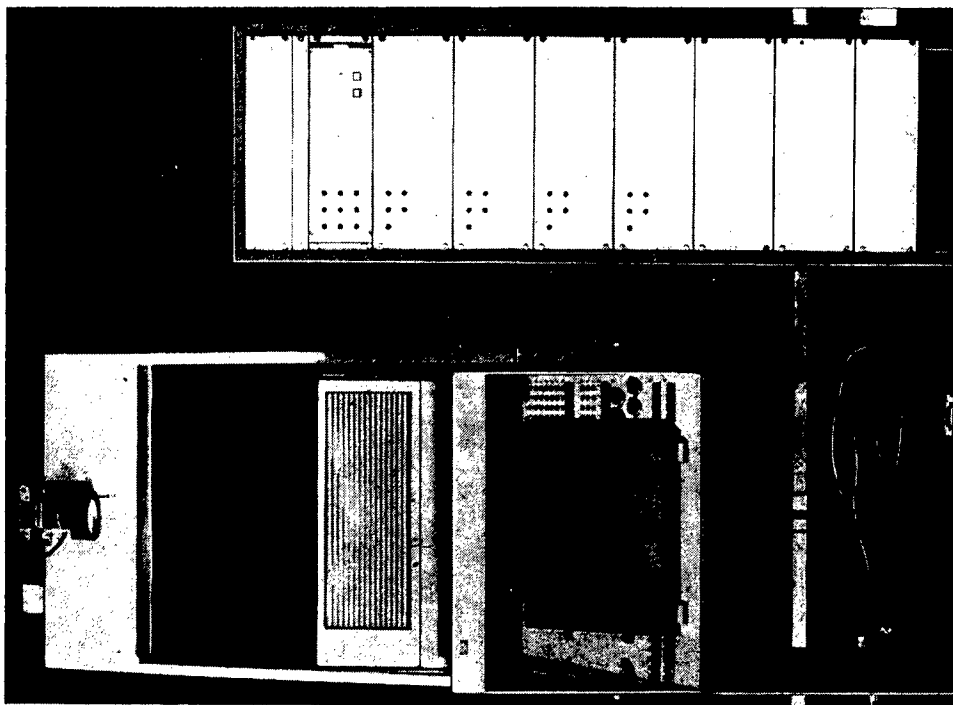


Fig. 2. The MSP-4 multispectral projector.

aspects of features and phenomena such as size, configuration, structure, texture and the like, and the spectral characteristics of features such as gray tone, color, radiation intensity and the like. The photographs are of high resolution and provide pictures in proper scale. The spectral range of 400 to 1100 nm may be used. Interpretation of the photographs requires a high degree of expertise. The atmospheric effects must be taken into account. In order to obtain the maximum information useful in agriculture, forestry, hydrology, geology, geography, transportation, mining, and so forth, use must be made of advanced techniques. A program is presented. Photographs show the two instruments.

[148]

5303

-END-

CSO: 1866